PORTABLE COMPUTER

Formula-1®

USER'S MANUAL

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[1] General Description

The Formula-1, all-in-one portable computer, is developed for anyone who needs a complete business computer system at a reasonable price, is miniaturized and lightened to be portable. This computer is a high-performance and multi-purpose micro-computer system, consist of 2 disk drives of 5.25" two-sided double density (approximate recording capacity is 716K bytes after Format), 5.5" CRT, Keyboard, Thermal Printer, EP-ROM Programmer as well as Serial & Parallel I/O Interface, all packed in one case.

Further., it is possible to write-in & read-out EP-ROMs, and use for personal computing easily. It is available as a powerful software development tool and a complete business computer system, if a line printer, 8" floppy disk drive, etc. are being externally connected.

The Formula-1 uses the CP/M-80 Version 2.2 as an Operating System, therefore the software developed by other computer systems of different architecture can keep mutual-transferability, as long as they are based on the CP/M-80 Operating System. The CPU of this computer is Z80A, which enables high speed processing.

The memory of the Formula-1 being equipped with RAM 64K bytes along with Boot-Strap ROM 4K bytes. RAM is 64K bits x 8 dynamic RAM and all of the 64K bytes memory spaces are used for user-programmable area. ROM is 4K bytes EP-ROM, used only for Boot-Strap. At the state of Boot-Strap the system program will be loaded from the 5.25" floppy diskette into the main memory.

The user can access directly, due to the I/O control program, which has been allocated in the fixed area. Expansion floppy disk drive can be expanded to 2 units, either by 5.25" or by 8" floppy disk drives. These devices can be used as an external memory with a maximum capacity of 2M bytes by connecting two 8" floppy disk drives of two-sided double density.

The EP-ROM Programmer on the Formula-1 can be operated in conversational style with CRT and keyboard. You can write-in and read-out 4 kinds of EP-ROMs, which are as follows:-
2716 (Intel) / 2516 (TI), 2732 (Intel), 2532 (TI) and
. 2764 (Intel).

Besides the 2 Serial I/O Ports of RS-232-C, 2 Parallel I/O Ports of 8-bits, Bigger CRT Interface are equipped in standard. RS-232-C can use either Synchronous or Asynchronous mode (Start Stop Synchronous). In standard, both ports are Start Stop Synchronous mode. The Parallel I/O Ports are programmable and. can designate I/O by bit-unit according to the program. Usually, this port is used for an external printer. You can only connect directly, external printer with Centronics Stand- Interface. You can also connect an external bigger CRT which being driven by composite video signal.

【2】System Architecture

Following shows the block diagram of the Formula-l.


```
                    CPU
                    Z80A

    BOOT-STRAP      MEMORY
    ROM 4 K/B       RAM 64 K/B

        DMAC        KEY BOARD
     Z80A DMA       CONTROLLER      ASCII K/B

         CTC
       Z80A CTC                                    Bigger
                                                    CRT
  80 COLUMNS
  5"THERMAL     PRINTER          CRT              5.5"
   PRINTER      CONTROLLER       CONTROLLER        CRT

                                                            *1
  PROM PROGRAMMER   FLOPPY DISK                  5.25" FDD
    CONTROLLER      CONTROLLER
                                  5.25" FDD

  2716/2516,                                                *2
  2732,2532,
  2764           SERIAL I/O      PARALLEL I/O
                 CONTROLLER      CONTROLLER       8" FDD

  RS-232-C     RS-232-C OR       DRIVER
  CHANNEL A    CURRENT LOOP        &
               CHANNEL B        RECEIVER

                                CENTRONICS I/F
                                   PRINTER
```

(*1 or *2 : Expansion Floppy Disk Drives)

Fig. 1 : Formula-l Hardware Block Diagram

【3】System Features

1. The Z80A CPU operating at 4 MHz being used in the Formula-l.

2. **The** main memory consist **of** 64K bits x 8 dynamic RAM, and the memory capacity for the user's programmable area being **64K** bytes.

3. This system is very reliable due we are using many kinds of LSI and multi-layered PCB.

4. As a result of using DMA, the data transfer is in high **speed,** and the burden of the software being decreased.

5. The system's CRT has semi-graphic function.

6. **Loaded with** EP-ROM Programmer enables you to write-in and read-out 4 kinds **of** EP-ROMs (2716/2516, 2732, 2532 and 2764) on the **CP/M-80** basis.

7. All the necessary devices are packed in one case, miniaturized and lightened to be portable sufficient for data processing purposes.

8. The **CP/M-80** is used as an Operating System of the Formula-l.

9. Various kinds of application software packages are available on the **CP/M-80** basis.

【4】Physical Characteristics

Dimensions	424(W) x 555(D) x 212(H) mm
Weight	15 kgs
Power Supply	AC110V±10%, 50/60Hz o r AC230V±10%, 50/60Hz
Power Consumption	Maximum 200W Fuse : AC110V-2A, AC230V-1A
Environment	Operating temperarare is from 5° C to 40° C.
	Preservation temperature is from –10° C to 55° c . (But a diskette is from 10" C to 50° C.)
	Relative humidity (no dewdrops) **is from** 10% to 90%.

[5] Hardware Specifications

[5]-1 C P U

Device	Z80A CPU (Clock: 4 MHz)
Word Size	8 bits/byte
Processing Method	8 bits parallel binary
Commands	1-4 bytes/command, commands-158

[5]-2 Memory

Device	ROM: EP-ROM 4K bytes RAM: Dynamic RAM 64K bytes (64K bits x 8)
Use	ROM: Initial Program Loader (IPL & X/O Control Program) RAM: Main Memory of 64K bytes used for user's programmable area.
DMA Transfer	Memory to Memory, Memory to I/O

[5]-3 D M A

Device	Z80A DMA
Mode	Byte (cycle steal) & Burst Mode
Functions	Data transfer between 2 Ports (I/O or Memory), Search of 8 bits data COmbination of data transfer and data . search between 2 Ports.
Channels	1 channel (2 Ports)
Use	Floppy disk drive Serial I/O Port Parallel I/O Port Memory
Interruption	Break-Out of Interruption Vector according to conditions DMA demand End of data transfer Matching at data searching

[5]-4 CTC(Counter & Timer)

Device	Z80A CTC
Channels	4 Channels (Channel #0 - Channel #3)
Clock	4 MHz at Timer Mode
Mode	Counter & Timer Mode
Channel #0	8 bits Programmable Timer
Channel #1	Baud-Rate setting of Serial I/O Channel-A
Channel #2	Baud-Rate setting of Serial I/O Channel-B
Channel #3	8 bits Programmable Counter & Timer
Interruption	Break-out of Interruption Vector according to demand of each channel * Zero Count * Time Out

[5]-5 Floppy Disk Drive

Type of Disk Drive	5.25" two-sided double density x 2 units
Capacity	358K bytes/disk drive
Data Bytes/Sector	128 bytes/sector(FM), 256 bytes/sector(MFM)
Sectors/Track	18 sectors/track
Cylinders/Disk Drive	40 cylinders/disk drive
Tracks/Disk Drive	80 tracks/disk drive
Recording Method	FM/MFM (Track 0, Side 0 - FM method)
Recording Density	2938 BPI (FM), 5876 BPI (MFM)
. Track Density	48 TPI
Rotational Speed	300 RPM
Data Transfer Rate	125K bits/sec (FM), 250K bits/sec(MFM)
Transfer Method	DMA Transfer
Average of Access Time	100 mS
Average of Seek Time	93 mS

Seek Time	6 mS
Settling Time	15 mS
Head Load Time	50 mS
Motor Start Time	400 mS

[5]-6 Video Display

CRT Size	5.5" (Green, non-glare coating), 95(H) x 70(V) mm
Characters	80 columns/line x 24 lines
	English/Figures, Small Letters of English, Marks - Total 96
	Reserved capacity : 64
	Semi-graphic patterns - Total 96
Format	6 x 7 dot matrix : character mode 8 x 8 dot matrix : semi-graphic mode
Cursor	Underline blinking (16 frames interval)
Mode	Non-interlace mode
Method	Video RAM method (I/O map)
Video RAM Capacity	2K bytes, static RAM
Character Generator	2K bytes EP-ROM
Character Code	ASCII
Interface	TTL level (active logic), separate type
	* Video Signal * Horizontal Synchronous Signal * Vertical Synchronous Signal
Expansion Interface	Composite video signal for bigger CRT, 1.5V P-P (Video: 1.0V)
Gain	23 dB
Video Frequency	16 MHz
Horizontal **Frequency**	60 Hz (free run oscillator)
Vertical **Frequency**	15.77 KHz (free run oscillator)

[5]-7 Thermal Printer

Method	Thermal
Characters	80 columns/lines (maximum)
	English/Figures, Small Letters of English, Marks - Total 96
	Reserved capacity : 64
	Semi-graphic patterns - Total 96
Format	5 x 7 dot matrix : character mode 7 x 7 dot matrix : semi-graphic mode
Line Spacing	4.5 mm
Direction	. From left to right
Character Generator	2K bytes, EP-ROM
Character Code	ASCII
Printing Width	103 mm
Paper	127(W) x 65(Dia.) mm roll paper No. TP-50CA127 by Jujo Seishi

[5]-8 EP-ROM Programmer

EP-ROM	* 2716 (Intel) / 2516 (TI) * 2732 (Intel) * 2532 (TI) * 2764 (Intel)
	However, programming voltage for 271612516, 2732 is 25V and 2764 is 21V.
Programming Pulse	50 mS (Hardware Timer)
Selection of EP-ROM	Programmable

When using EP-ROM, you should adjust the slide switch on the right of EP-ROM socket UP or DOWN, according to specific EP-ROM, you intend to use.

```
2716 / 2516, 2732 & 2532 ---- switch UP.
2764 ---------------------- switch D(.
```

[5]-9 Keyboard

Arrangement   Full-Keys (Conformed to **ASCII format)** + **Numeric-Keys +** Function-Keys

Code   ASCII Code

Shift Mode   Shift code of Full-Keys being output by holding <SHIFT> key down **and press** Data-Keys **at the same time.**

Control Mode   Control code **01(H)-1A(H) being output** by holding **<CTRL> key down and press Data-Keys at the same time.**

Function-Keys   * **F1** , **F2** , F3 , **F4** , **F5** , F6 , **F7** , **F8** , **F9**

These key codes **are** assigned 8 bytes by 'FUNC' **command** of System Utility Program.

* HOME , → , ← , ↑ , ↓

These cursor control key codes are assigned 2 bytes by 'FUNC' command **of System** Utility **Program.**
At the first time these **key codes are initialized as** follows.

HOME	<ESC> 'H'
→	<ESC> 'C'
←	<ESC> 'D'
↑	<ESC> 'A'
↓	<ESC> 'B'

Numeric-Keys   These **keys can** be programmed **as** Function-Keys if you do **not intend** to **use** for **numeric** entry. The codes **are** assigned 2 bytes by **'FUNC'** command **of** System Utility **Program.**

Special-Keys   *RESET : System-Reset key.
The system is set at initial state by holding **<CTRL>** key down and press <RESET> key at the **same** time.

*FEED : Roll Paper Feed **Key.**
Roll paper is fed by hitting this key.

*CAP LOCK : Capstan Lock Key.
By locking this key, alphabet is changed from lower **case** to upper case.

* SHIFT LOCK : Shift Lock **Key.**
By locking this **key,** full keys are changed to shift mode.

Scanning Method   Hardware Scanning

Inter Lock   N-Key roll over

Character Generator 2K bytes, EP-ROM

Switches   Momentary & Alternate, Mechanical contact

Chattering   Less than 5 mS

Key Top   Step sculpture type

Letters   With legend (double-shot molding)

Numbers of Key   91 keys

The **Keyboard** layout is on the following page.

Fig. 2 : Keyboard Layout

(*1, 2)

*1. The system is reset by means of hitting this key with 'CTRL'- key. There is no output of key code if you hit this Key.

*2. The 'FEED' - key forward the roll paper of the printer.

Device	Z80A SIO
	* Asynchronous (Start Stop Synchronous) * Synchronous * HDLC/SDLC
Channels	2 Channels (Channel-A, **Channel-B)**
Baud-Rate Clock	CTC (Programmable)
Baud-Rate .	* Asynchronous mode 150, 300, 600, 1200, 2400, 4800, 9600, 19200 BPS * **Synchronous mode** 300, 600, 1200, 2400, 4800, 9600, 19200, 38400 BPS **Set by DIP-Switches,** each **channel independently.**
Interface	* **Channel-A : RS-232-C** * **Channel-B : RS-232-C** or 20mA Current-Loop
DMA	**When Transmitting/Receiving buffer is at** state **of readiness. It is possible to** input **to CPU, DMA** transfer request **by specific** program.
Interruption	Break-Out **of Interruption** Vector by the **following conditions are only possible with specific program.** * Transmitting **buffer is empty.** * Receiving character **is valid.** * Change of status * Break-out errors (Parity, Over Run, Framing, End of Frame)

Device	**Z80A PIO**
	* Byte output mode * Byte input mode * Byte bi-directional mode (only Port-A) *· Bit mode
Port	8 bits x 2 ports (Port-A, Port-B)
Handshake Line	2 lines each port (Ready, Strobe)
Interface	**TTL** level (Using Centronics Standard Interface as our standard.)
DMA	The DMA transfer requests Break-Out by the in coming **'DMAREQ** signal from outside the system unit. Therefore, it is possible to input to CPU, DMA transfer requests by specific program.
Interruption	Break-Out of Interruption Vector by the **following conditions are only possible** with **specific program.**

* Receiving strobe **signal from the** external devices at the byte output **mode.**

* Receiving strobe **signal from** the **external** devices at the byte input mode.

* Receiving strobe **signal (for input or output) from the external devices at** the byte bi-directional mode.

* When the conditions **are** true at the state of bit mode.

【 6 】 Expansion Interface Specifications

The Formula-l's Expansion Interface **Specifications are as follows.**

* **5.25" floppy disk** drives (FD-5)
* 8" floppy disk drives **(FD-8)**
* Centronics Standard **Interface Printer   (FP-80)**
* **RS-232-C Serial Interface**
* 20mA Current-Loop **Serial Interface**
* Bigger CRT which is driven by **composite video signal. (FM-9)**

By using connectors on the rear side, expansion devices can be connected directly.   Further, **Baud-Rate of Serial** Ports **and Jumper can** be **set respectively.**
The layout of the rear view is **as** follows.

Fig. 3 : Rear View of the Formula-l

[5]-11 Parallel I/O Ports

Device	**Z80A PIO**

* **Byte** output mode
* Byte input mode
* Byte bi-directional mode (**only Port-A**)
* **Bit mode**

Port	8 **bits** x 2 ports (Port-A, Port-B)
Handshake Line	2 lines each port (Ready, Strobe)
Interface	**TTL level (Using Centronics** Standard Interface as our standard.)
DMA	The **DMA** transfer requests Break-Out **by the in coming 'DMAREQ' signal from outside the system unit.** Therefore, **it** is possible to input to CPU, DMA **transfer** requests **by** specific program.
Interruption	**Break-Out of Interruption Vector by the following** conditions are only possible with specific program.

* **Receiving strobe signal** from **the external** devices at **the byte output mode.**

* Receiving **strobe signal from the** external devices **at** the **byte** input mode.

* Receiving **strobe** signal (for input or output) **from the** external devices at the byte bi-directional mode.

* **When the conditions** are true at the state **of bit mode.**

【6】Expansion Interface Specifications

The Formula-l's Expansion Interface Specifications are as **follows.**

* 5.25" floppy disk **drives (FD-3)**
* **8" floppy** disk **drives** (FD-8)
* **Centronics** Standard **Interface** Printer (FP-80)
* RS-232-C **Serial** Interface
* 20mA Current-Loop Serial Interface
* Bigger CRT **which** is driven by composite **video** signal. **(FM-9)**

By using connectors on **the** rear aide, expansion **devices** can **be connected** directly. Further, **Baud-Rate of Serial Ports** and Jumper **can be set** respectively.
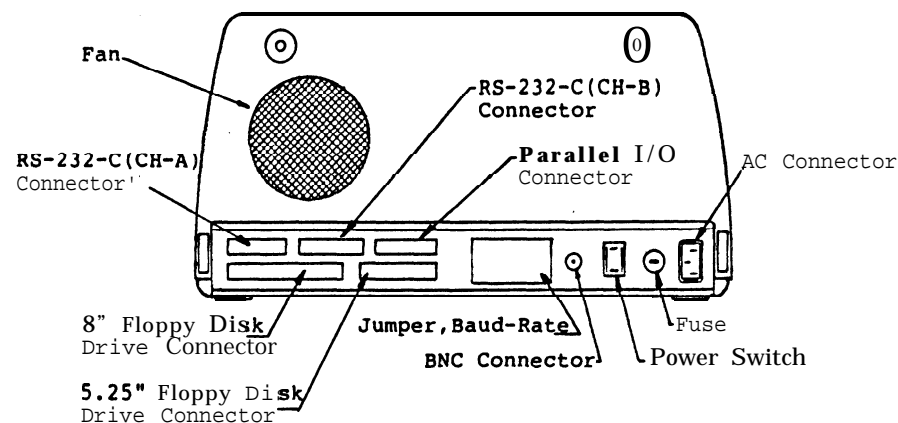The layout **of** the **rear** view is as **follows.**
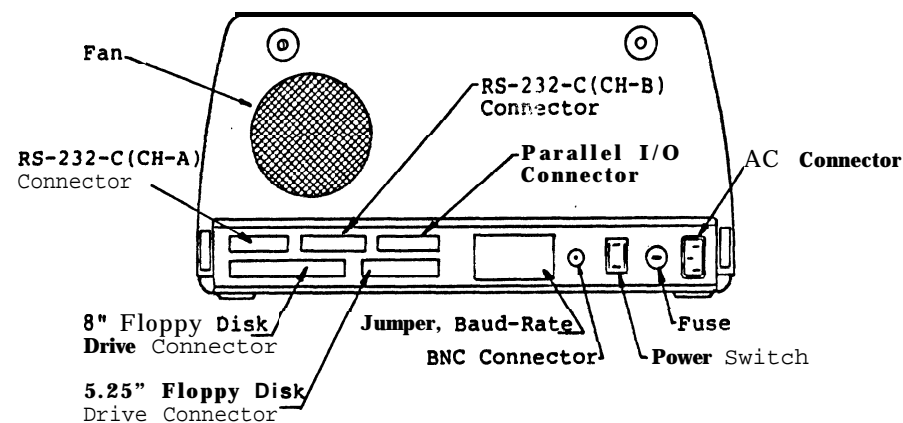
Fig. 3 : Rear View of the Formula-l

[6]-1 5.25" Expansion Floppy Disk Drives (FD-5)

The **Formula-l can** be **expanded to 2 disk drives by the same** specification as the system **floppy disk drive. In this case,** remove **the terminator from the expansion floppy disk drives.** Allocate **'#2','#3'** to physical disk **drive address because system** disk **drive has been** set up **on '#0','#1'.**

See the item No. < **[5]-5 Floppy Disk Drive** > about the specification of 5.25" floppy disk drive. Pertaining to the pin **assignment** of connectors and **the** signal **name, refer to below table.**

Pin number	Signal name	Pin number	Signal name
1	Signal Ground	2	
3	Signal Ground	4	
5	Signal Ground	6	DRIVE 3
7	Signal Ground	8	INDEX PULSE
9	Signal Ground	10	DRIVE
11	Signal Ground	12	DRIVE 1
13	Signal Ground	14	DRIVE
15	Signal Ground	16	MOTOR ON
17	Signal Ground	18	DIRECTION
19	Signal Ground	20	STEP
21	Signal Ground	22	WRITE DATA
23	Signal Ground	24	WRITE GATE
25	Signal Ground	26	TRACK
27	Signal Ground	28	WRITE PROTECT
29	Signal Ground	30	READ DATA
31	Signal Ground	32	SIDE SELECT
33	Signal Ground	34	DRIVE READY

Table 1 : Connector Signal of 5.25" Floppy Disk Drive

[6]-2 8" Expansion Floppy Disk Drives (FD-8)

The **Formula-l can** be **expanded to 2 disk drives (8")** of the following **specification. In this case,** remove the terminator from the **expansion** floppy disk drive. Allocate **'#2','#3'** to physical disk drive address because system disk drive has been assigned to **'#0','#1'.**

The pin assignment and the signal name are on the following page < Table 2 **: Connector Signal** of 8" **Floppy** Disk Drive >.

Type of Disk **Drive**	8" two-sided double density
Capacity	**997K** bytes
Data Bytes/Sector	128 bytes/sector (FM) 256 bytes/sector (**MFM**)
Sectors/Track	26 sectors/track
Cylinders/Disk Drive	77 cylinders/disk drive
Tracks/Disk Drive	154 tracks/disk drive
Recording Method	FM/MFM
Recording **Density**	3408 **BPI(FM),** 6816 BPI(MFM)
Track Density	**48 TPI**
Rotational Speed	360 RPM
Data Transfer Rate	250K bits/sec(FM), **500K** bits/sec(MFM)
Average of Access Time	83 mS
Average of Seek Time	91 mS
Seek Time	3 mS
Settling Time	15 mS
Head Load Time	50 mS

Pin number	Signal name	Pin number	Signal name
1	Signal Ground	2	LC/PC
3		4	
5		6	
7		8	
9	Signal Ground	10	TWO SIDE
11	Signal Ground	12	DISK CHANGE
13	Signal Ground	14	SIDE SELECT
15		16	
17	Signal Ground	18	HEAD LOAD
19	Signal Ground	20	INDEX PULSE
21	Signal Ground	22	DRIVE READY
23		24	
25	Signal Ground	26	DRIVE 0
27	Signal Ground	28	DRIVE 1
29	Signal Ground	30	DRIVE 2
31	Signal Ground	32	DRIVE 3
33	Signal Ground	34	DIRECTION
35	Signal Ground	36	STEP
37	Signal Ground	38	WRITE DATA
39	Signal Ground	40	WRITE GATE
41	Signal Ground	42	TRACK 00
43	Signal Ground	44	WRITE PROTECT
45	Signal Ground	46	READ DATA
47		48	I - - - - - - - I
49	I - - - - - - - I	50	

Table 2 : Connector Signal of 8' Floppy Disk Drive

[6]-3 Centronics Standard Printer Interface (FP-80)

In a standard specification of the Formula-1, Parallel I/O Port can be connected with the Centronics Standard Interface Printer directly.
As pin assignment of the Parallel I/O connector has no full compatibility to the Centronics Standard Printer Specification, for details refer to < Table 4 : Cable Connection for External Printer >.

The logic of Parallel I/O Ports are shown in the following page < Fig. 4 : Logic of Parallel I/O Ports >.

Besides the other signals, the Parallel I/O Ports possess, the signals of 'DMAREQ', 'COUNT', 'EXTCLK'.
The explanation of these signals are as follows.

1. DMAREQ (DMA REQuest) - Input

This signal is active 'Low', and available when using Parallel I/O for DMA transfer. Using this signal, it is necessary to set up the parameter in the DMA controller. This signal is connected to the 'RDY' terminal of DMA controller.

2 . COUNT (DMA transfer COUNT) - Output

This signal is active 'Low' and programmable, and when the number of byte of DMA transfer reaches a set value, a pulse signal is output. Thereafter, every 256 bytes of data transfer one pulse being output.

3. EXTCLK (EXTernal CLocK) - Input

This signal is active 'Low', and it is the input signal of the External Clock at the time of using the Channel #3 on 'Counter Mode' of Z80A CTC.
See < Fig. 5 : Logic of Counter & Timer >.
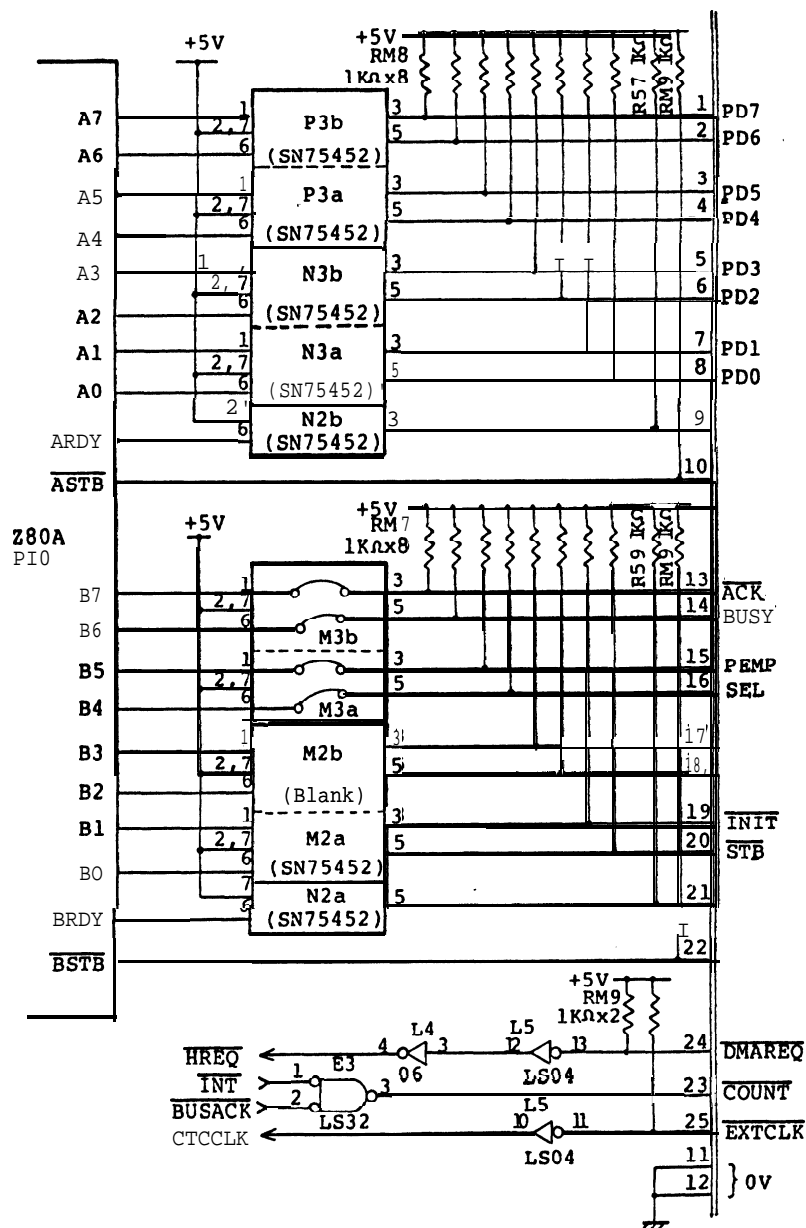
Fig. 4 : Logic of Parallel I/O Ports
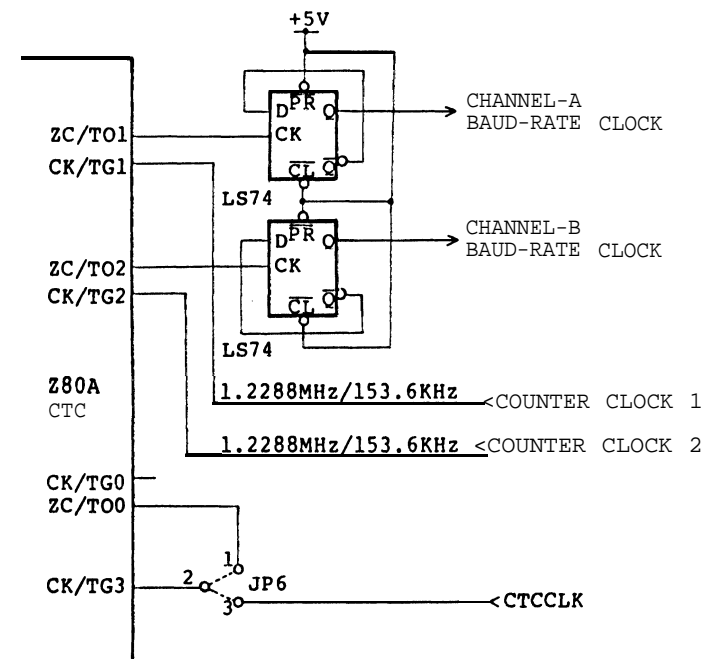
Fig. 5 : Logic of Counter & Timer

Pin Number	Signal Name	Contents	Signal Direction	Remarks	
1	PD7	Printing Data	OUT	PIOA7	
2	PD6	Printing Data	OUT	PIOA6	
3	PDS	Printing Data	OUT	PIOA5	
4	PD4	Printing Data	OUT	PIOA4	
5	PD3	Printing Data	OUT	PIOA3	
6	PD2	Printing Data	OUT	PIOA2	
7	PD1	Printing Data	OUT	PIOA1	
8	PD0	Printing Data	OUT	PIOA0	
9	ARDY	PIO-A Raedy	OUT	ARDY	*
10	ASTB	PLO-A Strobe	IN	ASTB	*
11	SG	Signal Ground			
12	SG	Signal Ground			
13	ACK	End of Operation	IN	PIOB7	
14	BUSY	Under Operation	IN	PIOB6	
15	PEMP	Out of Paper	IN	PIOB5	
16	SEL	-Printer Ready	IN	PIOB4	
17		Unused		PIOB3	
18		Unused		PIOB2	
19	INIT	Reset	OUT	PIOB1	
20	STB	Data Strobe	OUT	PIOB0	
21	BRDY	PIO-B Ready	OUT	BRDY	*
22	BSTB	PIO-B Strobe	IN	BSTB	*
23	COUNT	DMA Transfer Count	OUT	COUNT	*
24	DMAREQ	DMA Transfer Demand	OUT	DMAREQ	*
25	EXTCLK	CTC External Clock	IN	EXTCLK	*

Note : Do not connect (*) signed pins, when using Centronics Standard Interface Printer.

Table 3 : Connector Signal of Parallel X/O

-20-

Printer	Formula-1	Signal Name	Printer	Formula-1	Signal Name
1	20	STROBE	19	11	SG
2	8	DATA1	20	11	SG
3	7	DATA2	21	11	SG
4	6	DATA3	22	11	SG
5	5	DATA4	23	11	SG
6	4	DATA5	24	11	SG
7	3	DATA6	25	12	SG
8	2	DATA7	26	12	SG
9	1	DATA8	27	12	SC
10	13	ACK	28	12	SG
11	14	BUSY	29	12	SG
12	15	PEHP	30	12	SG
13	16	SELECT	31	19	RESET
14			32		
15			33		
16			34		
17			35		
18			36		

*SG = Signal Ground

3m

30 Rubber Insulated Flexible Cables

DB-C2-J9

57-30360

DB-25P

Side of the Printer   Side of the Formula-1

Table 4 : Cable Connection for External Printer

-21-
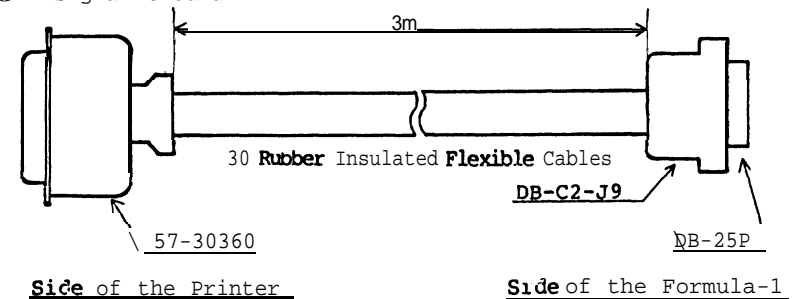
[6] 4   RS-232-C Inter face

In standard specification, 2 Serial I/O Ports of 'RS-232-C' are equipped with the Formula-1. Z80A SIO being used as the controller. For detail specifications, refer to the item No. < [5]-10 Serial I/O Ports >.

Channel-A is exclusive for 'RS-232-C'. The 'RS-232-C' and '20mA Current-Loop' of Channel-B can be changed by replacing the short plugs on the rear side of this computer.
For setting procedure of the short plugs, see the item No. < [8] Jumper Setting >.

Further, it is possible to set the Baud-Rate for each channel independently. For detail see the item No. < [9] Baud-Rate Setting >.

You can refer to < Fig. 6 : Logic of Serial I/O Ports > which shows the circuit of the Serial I/O Ports. About the pin assignment of the connector and the signal name, see < Table 5 & 6 : Connector Signal of RS-232-C (CH-A),(CH-B) >.

[6]-5 Bigger CRT Interface (FM-9)

Composite Video Signal Interface is equipped in standard. If you want to use bigger CRT, you can connect composite video monitor to the rear side connector 'BNC'.
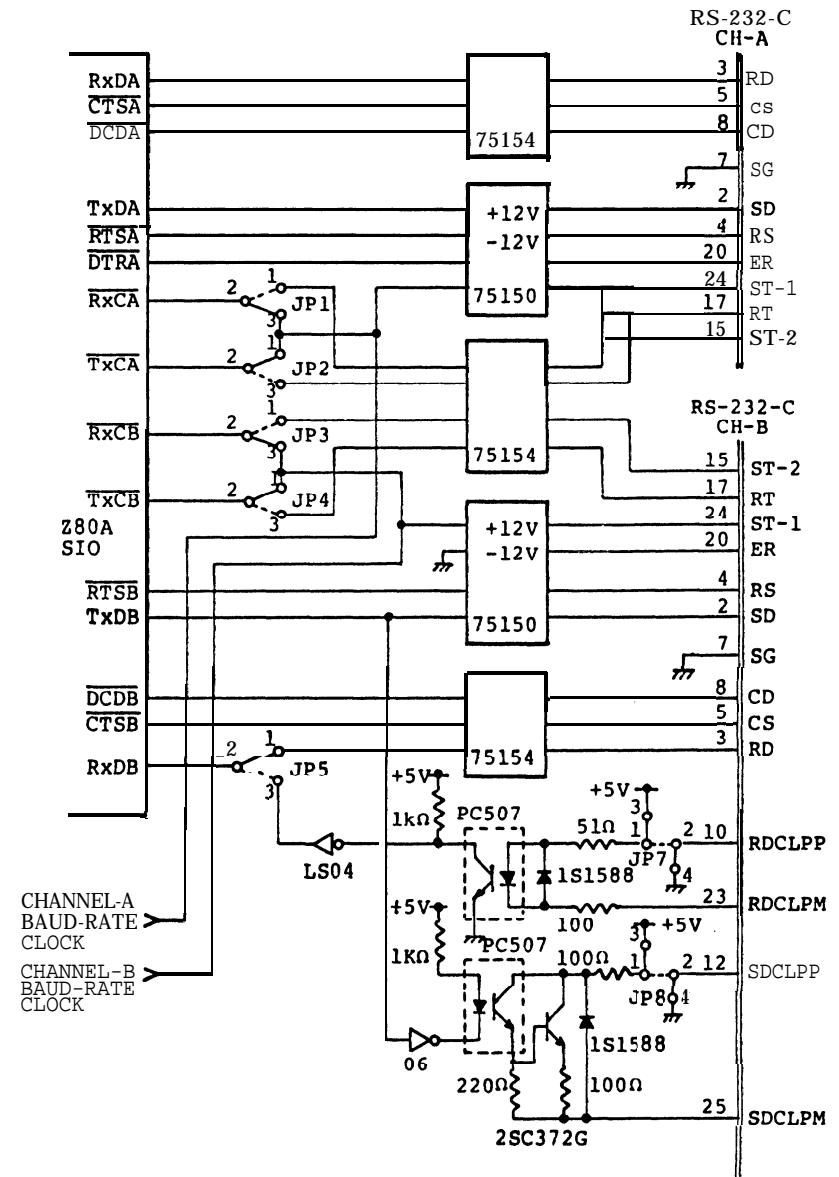
Fig. 6 : Logic of Serial I/O Ports

Pin Number	Signal Name	Remarks
1	FG	Frame Ground
2	SD	RS-232-C Send Data
3	RD	RS-232-C Receive Data
4	RS	Request to Send
5	CS	Clear to Send
6		
7	SG	Signal Ground
8	CD	Carrier Detect
9		
10		
11		
12		
13		
14		
15	ST-2	Send Timing (From MODEM)
16		
17	RT	Receive Timing
18		
19		
20	ER	Data Terminal Ready
21		
22		
23		
24	ST1	Send Timing (To MODEM)
25		

Table 5 : Connector Signal of RS-232-C **(CH-A)**

Pin Number	Signal Name	Remarks
1	FG	Frame Ground
2	SD	RS-232-C Send Data
3	RD	RS-232-C Receive Data
4	RS	Request to Send
5	CS	Clear to Send
6		
7	SG	Signal Ground
8	CD	Carrier Detect
9		
10	RDCLPP	20mA Current-Loop Receive Data **(t)**
11		
12	SDCLPP	20mA Current-Loop Send Data **(+)**
13		
14		
15	ST-2	Send Timing (From MODEM)
16		
17	RT	Receive Timing
18		
19		
20		
21		
22		
23	RDCLPM	20mA Current-Loop Receive Data **(-)**
24	ST1	Send Timing (To MODEM)
25	SDCLPM	**20mA** Current-Loop Send Data **(-)**

Table 6 : Connector Signal of RS-232-C (CH-B)

【7】Expansion Device Connection

【7】-1 FM-9 Bigger CRT Connection

Power Switch ON/OFF

Brightness Control Knob
/Contrast Control Knob

Fig. 7 : FM-9 Bigger CRT

Pin Jack Connector

AC Power

BNC Connector

AC Power
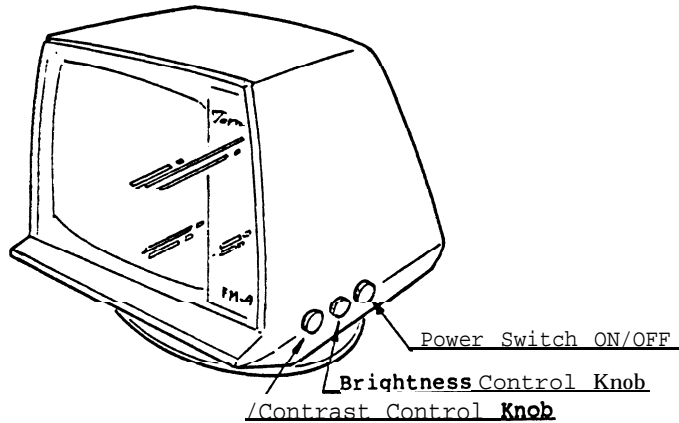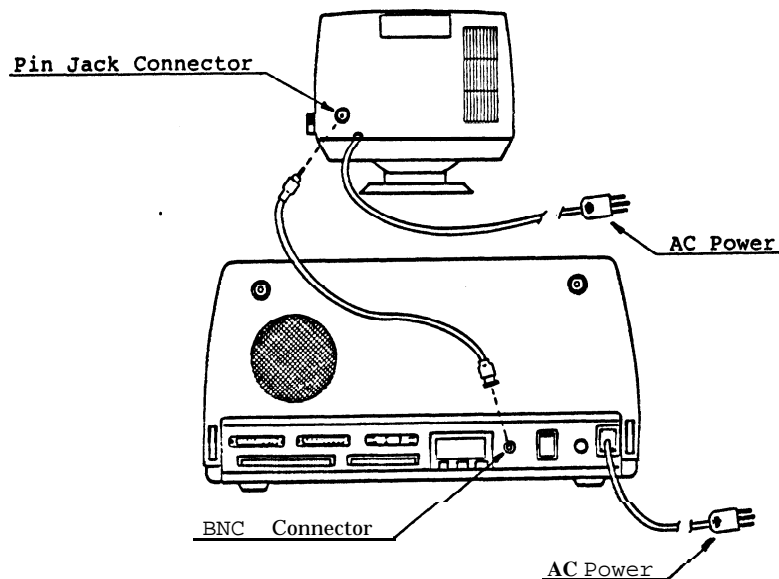
Fig. 8 : FM-9 Cable Connection

【7】-2 FD-5 & FD-8 Floppy Disk Drives Connection

You can connect **with** the Formula-l **maximum 2 units of** Expansion Disk Drives, details are as follows:-

(1) 5.25" Disk Drive (double density) x 2 units (FD-5)
(2) 8" Disk Drive (single density) x 2 units (FD-8)
(3) 8' Disk Drive (double density) x 2 units (FD-8)

Our FD-5 (5.25') and FD-8 (8') disk drives are two units of two sided double density disk drives. Therefore, you can **use** single density (8" only) as well as double density diskettes as per your requirement.

For your information, when using **FD-5** or FD-8 with Formula-l you **do** not need to set physical address. The terminator has already been detached from the disk drives. Because this is being set as per our company's standard peripherals to **use** simultaneously with Formula-l.

However, you may have to refer < Table 7 : Expansion Floppy Disk Drives Address > time to time to use different diskettes due logical address (drive name) being assigned separately for each drives.

Type of diskette	Description	Physical address	Logical address
5.25"	two-sided double density	DS2	c
	two-sided double density	DS3	D
8"	one-sided single density	DS2	E
	one-sided single density	DS3	F
	two-sided double density	DS2	G
	two-sided double density	DS3	H

Table 7 : Expansion Floppy Disk Drives Address

Disk Drive "In Use" Indicator

Diskette Lock Lever

Power Switch ON/OFF
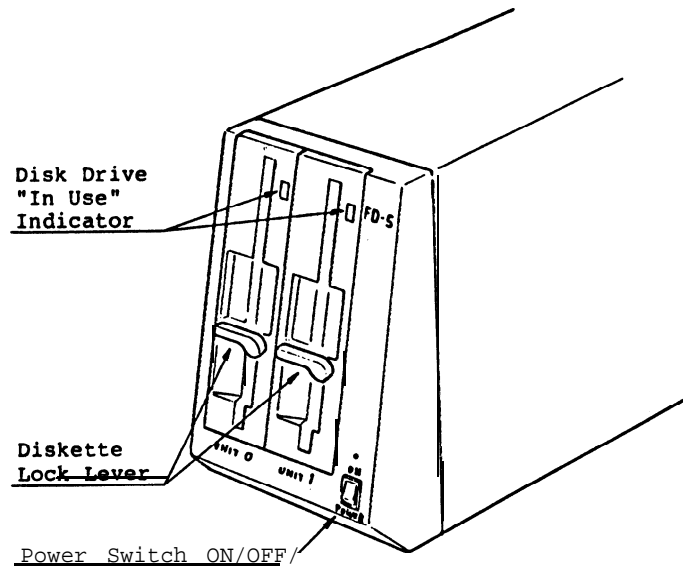
Fig. 9 **: FD-5** Floppy Disk Drive

Diskette Lock Lever

Disk Drive "In Use" Indicator

Power Switch ON/OFF

Fig. 11 **:** FD-8 **Floppy** Disk Drive

Gray Color Connector

AC Power

Black Color Connector

AC Power
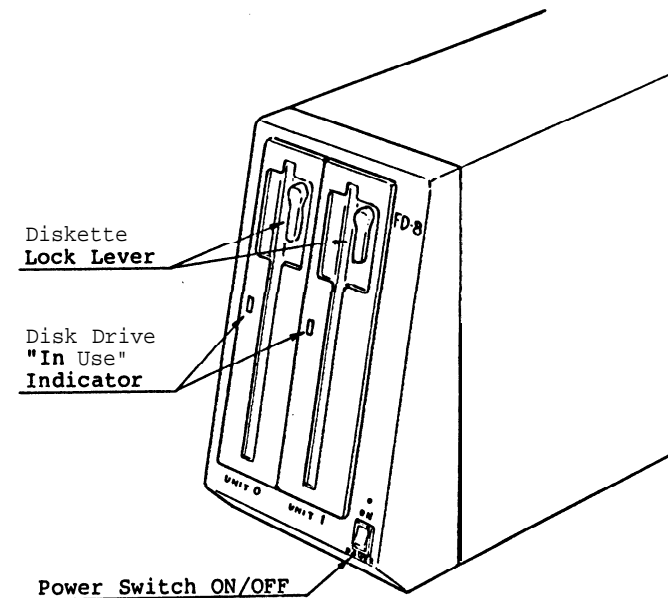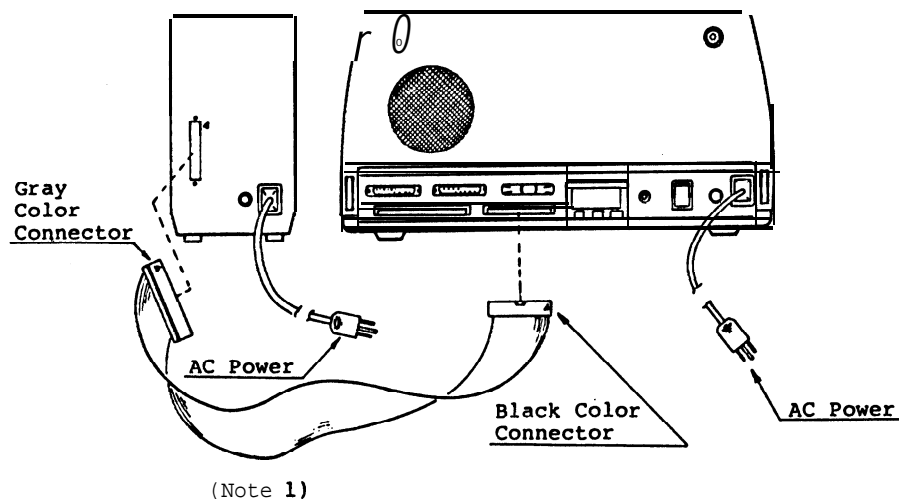
(Note 1)

Fig. 10 **: FD-5** Cable Connection

Gray Color **Connector**

AC Power

Black Color **Connector**

AC Power
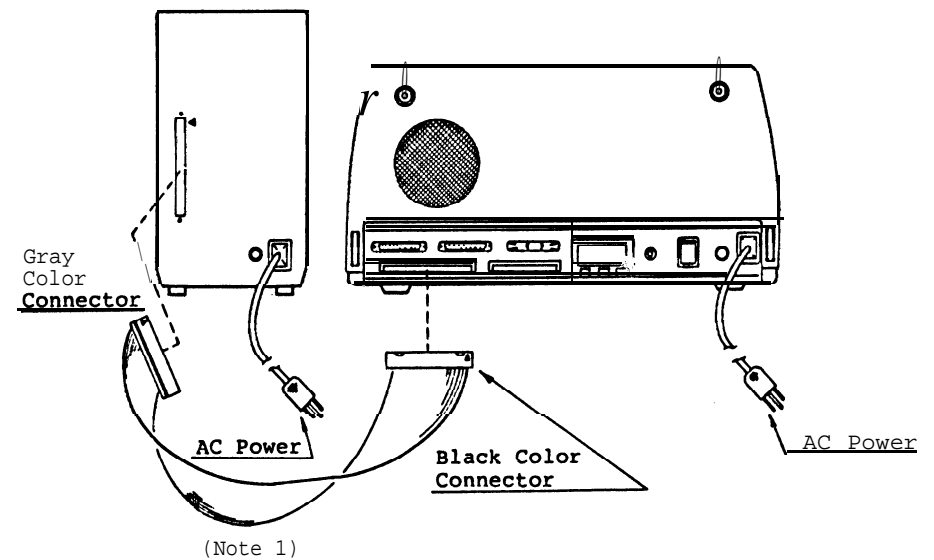
(Note 1)

Fig. 12 **:** FD-8 Cable Connection

Note 1 : **FD-5** and FD-8 disk drives flat cable connector's marks indicates to insert by matching with appropriate marks of the connecting sockets,

Note 2 : Be careful not to use **FD-5** and FD-8 together in the **same time .**

Due there being no exhaust fan in the disk drives (FD-5, **FD-8),** therefore to refrain from over heating you should put it 'OFF' when not using.

Do not put anything (paper, books, heavy manuals, diskettes etc.) on the drives, in order to have proper ventilation.

[7]-3 **FP-80 External Printer Connection**
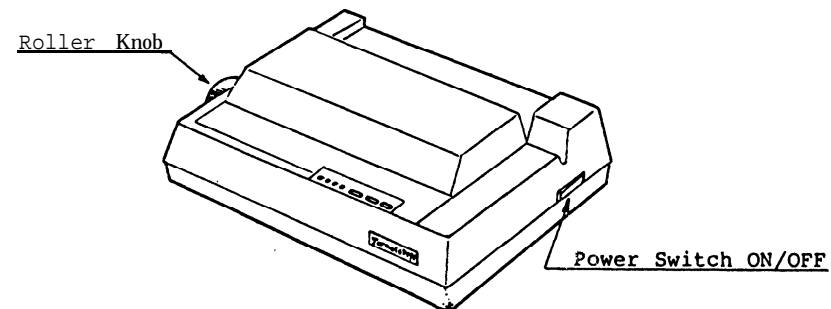
Fig. 1 3 : FP-80 External Printer
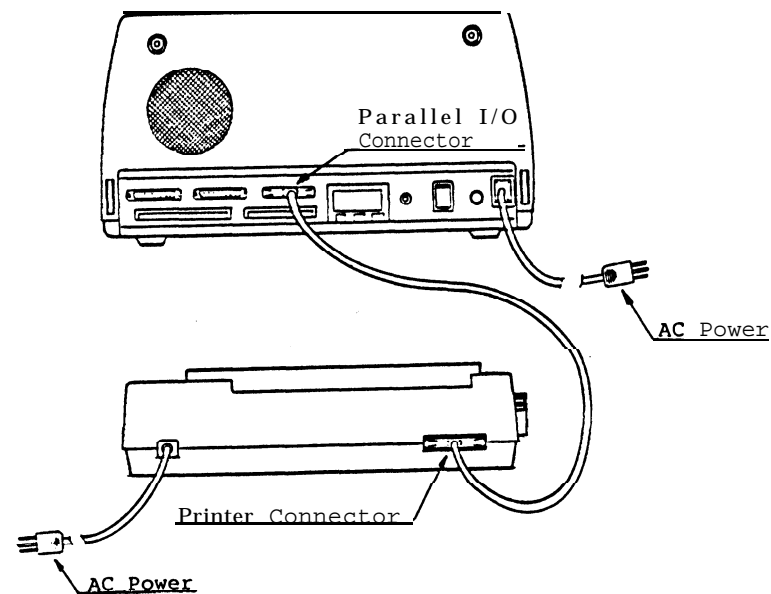
Fig. 14 : FP-80 Cable Connection

[8] Jumper Setting

This computer has eight jumpers for setting, from **JP1** to **JP8.** It is possible to set the jumpers by putting **short plugs on the jumper posts, which are** on the **rear side of Formula-L** The **role** of each jumpers **are on** the following page.
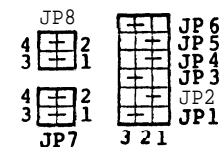
Jumper	Set	Contents	Remarks	
JP1	1-2	Used Ext. **Clock as** Receiving Clock	SIO Channel-A	
	2-3	Used Int. Clock as Receiving Clock	**SIO** Channel-A	*
JP2	1-2	Used Int. Clock as Transmitting Clock	SIO Channel-A	*
	2-3	Used Ext. Clock as Transmitting Clock	SIO Channel-A	
JP3	1-2	Used Ext. Clock **as** Receiving Clock	SIO Channel-B	
	2-3	**Used** Xnt. Clock as Receiving Clock	SIO Channel-B	*
JP4	1-2	Used Int. Clock as Transmitting Clock	**SIO** Channel-B	*
	2-3	**Used Ext.** Clock as Transmitting Clock	SIO Channel-B	
JP5	1-2	RS-232-C	SIO Channel-B	*
	2-3	20 **mA** Current-Loop	SIO Channel-B	
JP6	1-2	Used Counter Output of Channel #0 as **a** Clock Input of CTC Channel #3	**CTC Channel #3** (Counter Mode)	
	2-3	Used Ext. Clock **as a** Clock Input **of CTC Channel #3**	**CTC Channel #3** **(Counter Mode)**	*
JP7	1-2	**20 mA Current-Loop** **Non-Voltage Type**	SIO Channel-B (Receiving)	
	1-3 2-4	**20 mA Current-Loop** **Voltage Type**	**SIO** Channel-B (Receiving)	*
JP8	1-2	20 **mA** Current-Loop Non-Voltage Type	SIO Channel-B (Transmitting)	
	1-3 2-4	20 **mA** Current-Loop **Voltage** Type	SIO, Channel-B (Transmitting)	*

Note : Per our standard, jumpers being already **set as** shown by the **(*)** signs. You can also set jumpers as per your specific use. However, **in** each jumper you **need** to set **only one pair** of **pins.** Example:- for setting **JP1** either **you** set **(1-2) or** (2-3) **pins.**

Table 8 : Jumper Setting

【9】Baud-Rate Setting

The Baud-Rate of Serial I/O Ports **can be** set **for each** Channel-A and Channel-B independently.
Baud-Rate is formed by using **'Channel #1** (for Channel-A)' and.
'Channel #2 (for Channel-B)' of this computer's **Z80A** CTC.

The **Baud-Rate** is set by the DIP-Switch **on** the **rear** side.
When you intend **to change the Baud-Rate, never** fail to do System-Reset, otherwise **the** changed Baud-Rate **can not be set.**

Channel-A Channel-B

— Baud-Rate Selection
— Clock-Rate Selection
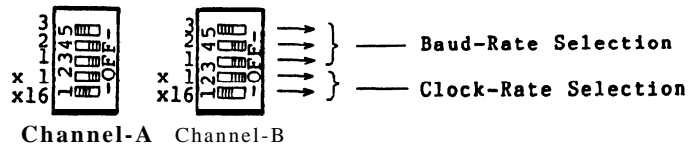
Switch Baud-Rate	DIP-Switch					
	3	2	1	x1	x16	
150	ON	ON	ON	OFF	ON	Asynchronous (**Start** Stop Synchronous)
300	OFF	ON	ON	OFF	ON	
600	ON	OFF	ON	OFF	ON	
1200	OFF	OFF	ON	OFF	ON	
2400	ON	ON	OFF	OFF	ON	
4800	OFF	ON	OFF	OFF	ON	
9600	ON	OFF	OFF	OFF	ON	
19200	OFF	OFF	OFF	OFF	ON	
300	ON	ON	ON	ON	OFF	Synchronous
600	OFF	ON	ON	ON	OFF	
1200	ON	OFF	ON	ON	OFF	
2400	OFF	OFF	ON	ION	OFF	
4800	ON	ON	OFF	ON	OFF	
9600	OFF	ON	OFF	ON	OFF	
19200	ON	OFF	OFF	ON	OFF	
38400	OFF	OFF	OFF	ON	OFF	

Table **9 : Baud-Rate Setting**

【10】 Initial Start

[10]-1   Memory Allocation and Boot-Strap ROM

The following shows the memory allocation of the Formula-1.
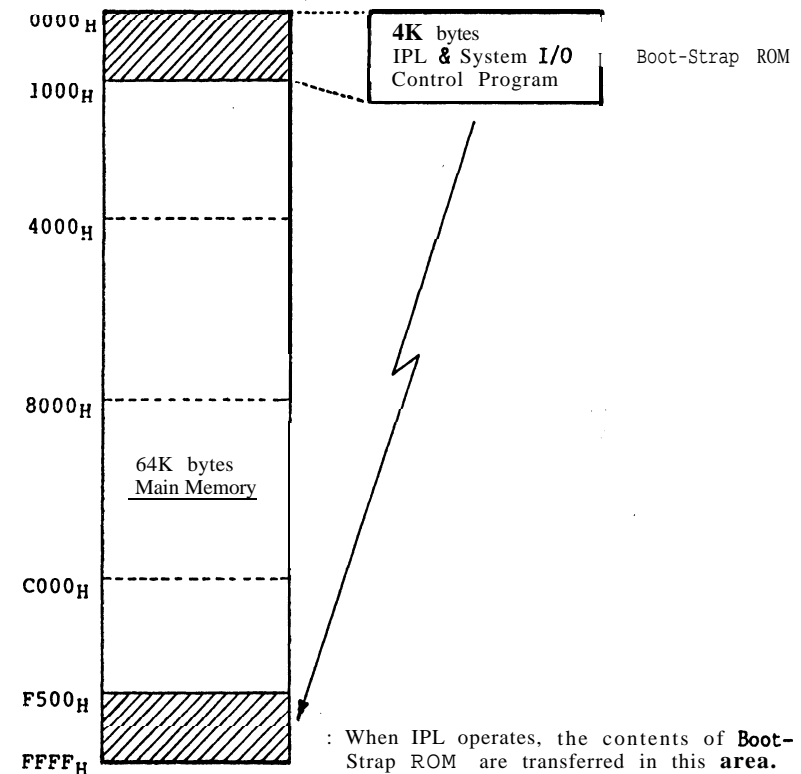
Fig. 15 : Memory Allocation

Only when setting the Power-ON or the **system** is reset, the Boot-Strap ROM becomes **at** readable state, thereby overlapped with main memory. During this time, **0000(H)-0FFF(H)** address of the main memory being at the state of "Write" only, and CPU executes the program in Boot-Strap ROM, By the output of ROM disable signal according to the program, Boot-Strap ROM is parted from the system, **and all** of main memory turns to the state of read/write.

In standard design, IPL, I/O Control Program, Expansion Device Control **Program,** etc., are stored in the Boot-Strap **ROM.**

After transferring the program to the address **F500(H)-FFFF(H)** of **the main** memory, **the program** jumps to IPL in this **area,** thereafter Boot-Strap ROM is parted from the system at the Power-ON or System-Reset. The following shows the memory **allocation** of the **Formula-1 when using the '60K CP/M-80'.**

```
0000H  ┌──────────────┐ ⎤
       │ System Area  │ ⎬ 256 bytes : System Parameter
0100H  ├──────────────┤ ⎦
       │              │
       │              │
       │              │
       │  User's Area │   53K bytes
       │              │
       │              │
       │              │
       │              │                    System Diskette
D400H  ├──────────────┤
       │   CCP Area   │ ⎤
DC00H  ├──────────────┤ ⎪  CP/M-80 : Loaded from a System
       │  BDOS Area   │ ⎬           Diskette
EA00H  ├──────────────┤ ⎦
       │  BIOS Area   │
       │ "--------L-II│ ⎤
F500H  ├──────────────┤ ⎬ Transferred from the Boot-Strap ROM
       │I/O Control Ar│ ⎦
FFFFH  └──────────────┘
```
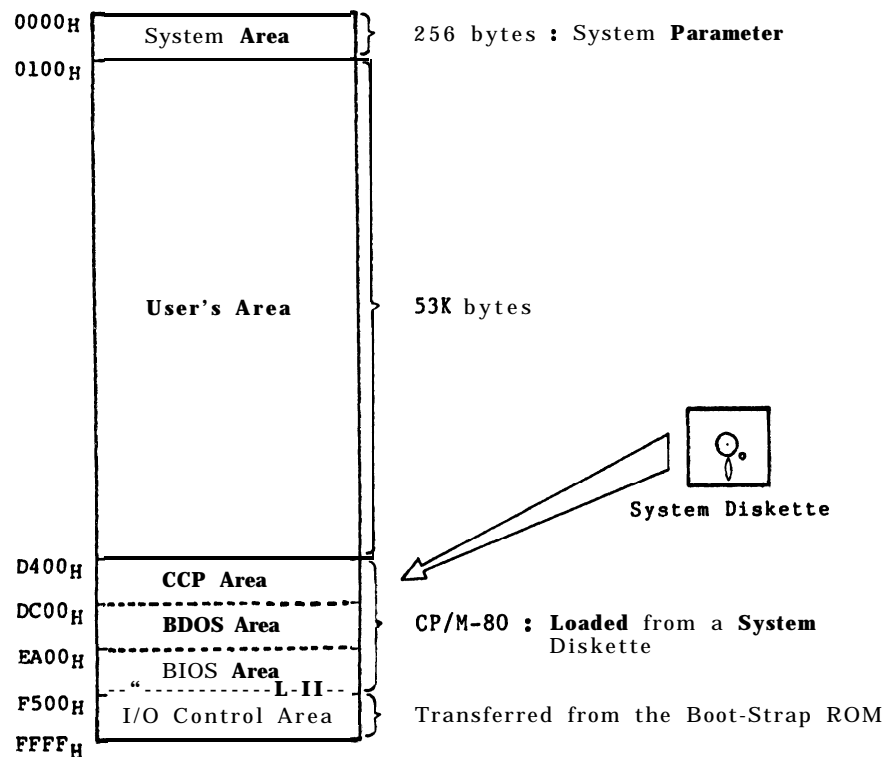
Fig. 16 : Memory Allocation Using **60K CP/M-80**

---

[10]-2 System Start

When you set the Power-ON or **System-Reset,** the IPL program starts immediately. The following message will appear on your CRT and the Boot-Strap program being loaded to the main memory from the system diskette.

Formula-1 IPL Vers. *.* for mini 2D

The Boot-Strap program is loaded to the following address.

```
0000H  ┌──────────────┐
       │              │
       │              │                       System Diskette
0100H  ├──────────────┤ ⎤
       │ Boot Program │ ⎬ 128 bytes
0180H  ├──────────────┤ ⎦    (Side   : 0
       │              │       Track  : 0
0200H  └──────────────┘       Sector : 1)
```
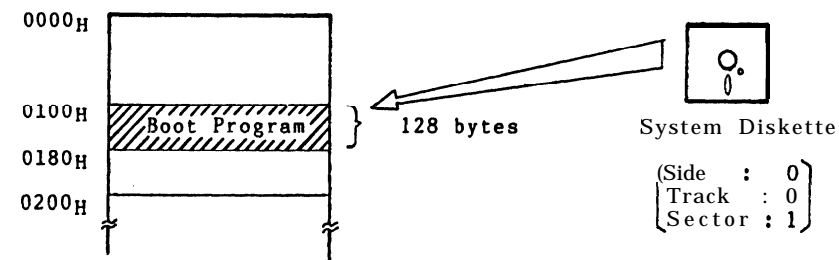
Fig. 17 : Boot-Strap Program Allocation

When the Boot-Strap program is loaded, if an error occurs, the following message will appear on your CRT, **and** the process of loading to the main memory restarts again.

IPL error !

When the Boot-Strap program is loaded correctly, the following message appears on your CRT, thereafter the system program is loaded into the main memory from the system diskette. In **case** of using the **CP/M-80,** the **system program is loaded** into **D400(H)-F4FF(H)** addresses.

See < Fig. 16 **:** Memory Allocation Using **60K CP/M-80** >

CP/M Boot Ver. ***.*** for **■ini 2D**

Then, if **an** error occurs, the following message will appear on your CRT, and the process of loading to the main **memory** restarts again.

Boot err.

When the Boot-Strap program is loaded correctly, the following message appears on your CRT, and the **CP/M-80** starts automatically.

*** 60K **CP/M Vers.** 2.2 Formula-l System *******
BIOS Created By YCU Co., Ltd. **(1983.**.**)**
A>▁▁▁▁▁ Cursor

[11] Software Specifications

[11]-1   Operating System

The Formula-l uses the **CP/M-80** Version 2.2 which is evaluated as the standard **Operating** System of 8 bits micro-computer in the world.

This Operating System can operate application programs and process data without difficulty because of its superior **multi-**purposed feature and excellent operating ability. For this reason, even the software developed for other computer systems of different architecture can keep mutual-transferability, as long as they are based on the CP/M-80 Operating System. Therefore, old libraries as well as know-hows already filed-in can be used easily.

See the **'CP/M-80** OPERATING SYSTEM MANUAL' for details of the **CP/M-80** commands. The Formula-l can use various kinds of application software packages on the **CP/M-80** basis available on the market.
The CP/M-80 is a standard Disk Operating System for the micro-computer.

The **CP/M-80** system is composed of CCP to process a command, BDOS to manage **access** of the file, BIOS to control the I/O device which a user **uses,** and TPA of the memory area in which a **user's program is allocated.**

The **CP/M-80** system is **a FDOS,** in which the sequential processing is main. Which **reads** out the **file** and executes when a command being input by the console and it corresponds to a program name. Using the **CP/M-80** System Functions, along with a user's program, a user can easily actualize the data transfer with I/O device, the management of the data file in the ·**floppy** disk drive, etc.

For detail memory allocation to use with the **CP/M-80** **Operating** System see the item No. **< [10]-1** Memory Allocation and Boot-Strap ROM **>.**
There **are** two kinds of commands in the ꟼP/M-80**. One** is built-in command, and the other is **a** transient command. The transient command being loaded into the memory **from** the diskette.

The following is built-in commands **of** the **CP/M-80.**

ERA	Erase specified files.
DIR	List file names in the directory.
REN	Rename the specified file.
SAVE	Save memory contents in a file.
TYPE	Type the contents of a file on the **logged** disk.

The following is transient commands of the **CP/M-80.**

```
STAT
ASM
LOAD
DDT
PIP
ED
SUBMIT
DUMP
MOVCPM
XSUB

FORMAT *
FSYSGEN *
SYSTEM *
PROMW *
FUNC *
```

Please refer to our **'CP/M-80** OPERATING SYSTEM MANUAL' for detail of the above commands.
Details for the commands with **(*)** sign are available In this manual.

---

[11]-2 CP/M-80 System Functions

The **CP/M-80** has 39 kinds of system functions. The user can set necessary parameters in the register or in the buffer, and **calls** the BDOS of the **CP/M-80.** So inside the BDOS, the job being executed by the given parameter, and the state being **returned to** the user's program automatically. The operations are generally divided into two classes. One is for the I/O device, the other is for the disk operation.

Following are the I/O Device Operation.

1. Read a Console Character
2. Write a Console Character
3. Read a Sequential Tape Character
4. Write a Sequential Tape Character
5. Write a List Device Character
6. Get or Set I/O Status
7. Print Console Buffer
8. Read Console Buffer
9. Interrogate Console Ready

The FDOS operations that perform disk I/O are.

1. Disk System Reset
2. Drive Selection
3. File Creation
4. File Open
5. File Close
6. Directory Search
7. File Delete
8. File Rename
9. Random or Sequential Read
10. Random or Sequential Write

11. **Interrogate** Available **Disks**

12. **Interrogate Selected Disk**

13. **Set DMA Address**

14. **Set/Reset File Indicators**

CP/M-80 functions and their numbers are listed below.

0	System Reset	19	Delete File
1	**Console Input**	20	**Read Sequential**
2	**Console Output**	21	**Write Sequential**
3	**Reader Input**	22	**Make File**
4	**Punch Output**	23	Rename **File**
5	**List output**	24	**Return Login Vector**
6	**Direct Console I/O**	25	**Return Current** Disk
7	**Get I/O** Byte	26	Set DMA **Address**
8	Set I/O Byte	27	Get **Addr(Alloc)**
9	**Print String**	28	**Write Protect Disk**
10	**Read Console** Buffer	29	**Get R/O Vector**
11	**Get Console** Status	30	Set File Attributes
12	**Return Version Number**	31	**Get Addr(Disk Parms)**
13	**Reset Disk System**	32	Set/Get **User** Code
14	**Select Disk**	33	**Read Random**
15	**Open File**	34	Write Random
16	**Close File**	35	**Compute File Size**
17	**Search** for **First**	36	**Set Random Record**
1 8	**Search for Next**	37	Reset Drive
		40	**Write Random** with **Zero Fill**

Functions 28 and 32 should be **avoided in application programs to maintain upward compatibility with CP/M-80.**

<u>Note</u> **:** For detail explanation you must refer to the topic **'CP/M 2 System Interface'** of the **'CP/M-80 OPERATING SYSTEM MANUAL'.**

---

[11]-3 Device Allocation

The following 4 logical devices are allocated in the CP/M-80.

CON **:** The System Console Device

RDR **:** The Paper Tape Reader Device

PUN **:** The Paper Tape Puncher Device

LST **:** The Output List Device

The **physical** devices **allocated for the Formula-l are** a8 **follows.**

CON **:** TTY, **CRT**

RDR **:** TTY

PUN **:** TTY

LST **:** TTY, CRT, **UL1,** LPT

    TTY = RS-232-C (Channel-B Port)

    CRT = System's CRT (Console Output Device)
         System's Keyboard (Console Input Device)

    UL1 = System's Thermal Printer

    LPT = Centronics Standard Interface Printer
        (Parallel I/O Ports)

When the power is turned 'ON', **the following is allocated.**

CON **:** CRT

RDR : TTY

PUN **:** TTY

LST **:** **UL1**

[11] -4   Expansion Floppy Disk Drives

The floppy disk drive, which **can** be **expanded** is limited to 2 units 5.25" or 8" disk drives only. **Details are as follows:-**

Drive A : System Floppy Disk Drive
(**5.25"** two-sided double density)

Drive B : System Floppy Disk Drive
(5.25' two-sided double density)

Drive C : **Expansion** Floppy Disk Drive
(5.25' two-sided double density)

Drive D : Expansion Floppy Disk Drive
(5.25" two-sided double density)

Drive **E :** Expansion Floppy Disk Drive
(8' one-sided single density)

Drive F : Expansion Floppy Disk Drive
(**8"** one-sided single density)

Drive **G :** Expansion Floppy Disk Drive
(8' two-sided double density)

Drive H : Expansion Floppy Disk Drive
(**8"** two-sided double density)

The logical and physical corresponds of the above devices are as follows.

<**Logical** Address>		<Physical Address>
Drive A	:	Drive **#0**
Drive B	:	Drive **#1**
Drive C	:	Drive **#2**
Drive D	:	Drive **#3**
Drive **E**	:	Drive **#2**
Drive **F**	:	Drive **#3**
Drive G	:	Drive **#2**
Drive H	:	Drive **#3**

Note **:** Drive '**A**' and Drive 'B' are mounted on the system unit.

[11] -5 BIOS

The BIOS must be **changed** to implement the CP/M-80 on the Formula-l. **The** BIOS made by our company supports the floppy disk drive of 5.25" two-sided double density, 8' two-sided double density and 8" one-sided single density. Refer to the item No. < **[11]-4** Expansion Floppy Disk Drives > for detail allocation of the disk drives.

Be careful of the following points. The Formula-l's files are compatible with the CP/M-80's files of 8' one-sided single density diskette. However, there are no compatibility with the CP/M-80's files of 5.25" and 8" two-sided double density diskettes. In case of copying the CP/M-80's files from the double density diskette made by the other company, the user must do so after once copying to the CP/M-80's files of 8" one-sided single density diskette.
See the item No. < **[11]-3** Device Allocation > about the device of Console, Reader, Puncher **and Printer.**

[11] -6 File Format

The filing format of the floppy disk drives being used in the Formula-l is **on the** following page.
The explanation of **8"** one-sided single density has been omitted.

[11]-6-1 5.25" Two-Sided Double Density Diskette

1. Format of Diskette

   Cylinder   40 cylinders/diskette

   Track   80 'tracks/diskette

   Sector   18 sectors/track

   Byte   128 bytes/sector (only track 0, side 0)
                     256 bytes/sector (except the above)

2. Format of the CP/M-80's File

   System Track   Track 0 (side 0 & side 1) and
                     Track 1 (side 0)

   Track   80 tracks/diskette
                     (side 0 : even-number tracks)
                     (side 1 : odd-number tracks)

   Sector   36 sectors/track (128 bytes/sector)

   Disk Capacity   346.5K bytes (except the system track)

[11]-6-2 8" Two-Sided Double Density Diskette

1. Format of Diskette

   Cylinder   77 cylinders/diskette

   Track   154 tracks/diskette

   Sector   26 sectors/track

   Byte   128 bytes/sector (only track 0, side 0)
                     256 bytes/sector (except the above)

2. Format of the CP/M-80's File

   System Track   Track 0 (side 0 & side 1)

   Track   154 tracks/diskette
                     (side 0 : even-number tracks)
                     (side 1 : odd-number tracks)

   Sector   52 sectors/track (128 bytes/sector)

   Disk Capacity   988K bytes (except the system track)

[11]-7 I/O Program Specifications

Each I/O control program is allocated to memory address F500(H). 51 bytes after F500(H) is the jump table for I/O control program, it is easy to control I/O device of the Formula-1 by calling subroutine. The following shows the structure of jump table and is stored in the Boot-Strap ROM.

Item	Address	Program Name	Contents
1	F500H	IPL	System I/O Initialize IPL (Initial Program Load)
2	F503H	FDC	System Floppy Disk Control Expansion Floppy Disk Control
3	F506H	CRT	System's CRT Control
4	F509H	PRINT	System's Printer Control
5	F50CH	KB	System's Keyboard Control
6	F50FH	KBSTS	System's Keyboard Status Check
7	F512H	LPRINT	Centronics Standard Printer Control (Parallel I/O Port)
8	F515H	UCRT	RS-232-C (Channel-B) Data Output
9	F518H	UKB	RS-232-C (Channel-B) Data Input
10	F51BH	USIOIN	RS-232-C (Channel-A) Data Input
11	F51EH	USIOOUT	RS-232-C (Channel-A) Data Output
12	F521H	LPRNST'S	Centronics Standard Printer Status Check
13	F524H	UCRTSTS	RS-232-C (Channel-B) Output Status Check
14	F527H	UKBSTS	RS-232-C (Channel-B) Input Status Check
15	F52AH	USIOISTS	RS-232-C (Channel-A) Input Status Check
16	F52DH	USIOOSTS	RS-232-C (Channel-A) Output Status Check
17	F530H	CRTINIT	System's CRT Initialize

Table 10 : Jump Table

Here is the example, we have presented in order to show, how to call subroutine program in order to control I/O devices.

This program has been written in assembler language, therefore, one should know assembler language programming very well before going into hand-on practice of this subroutine program. Please see our below example. In which we have shown the procedure to read a file by direct access method. We must specify that you can also read and write with the help of CP/M-80's BDOS procedure, although it takes a little longer time.

System Floppy Disk Control:-

The System Floppy Disk Drive Control operates by setting controlling information in the parameter area and calling subroutine.

1. At first, you should set total 13 bytes in the parameter area.

   For example:- Refer to the < Table 12 : FDC Program Parameter >, field columns (1 to 13) means total 13 bytes are available. You can also look for detail information such as parameter, length and contents.

2. Now, you look at the < Table 16 : Memory Allocation of FDC Program Parameter >.

3. Insert CP/M diskette into drive 'A'.

4. Type 'DIR' press <RETURN>. Get directory of the drive 'A'.

5. Look for 'ED COM' file as Editor command file.

6. Now, type 'ED EXAMPLE.ASM' press <RETURN>. (For detail, please refer to our Formula-1's CP/M-80 OPERATING SYSTEM MANUAL's page 33 'Introduction to ED' thoroughly.)

7. You will get a new file on your CRT and following appears on it:-
   :*

8. Press 'I' and <RETURN> key. Automatically, you will get list number in order to input your program.

9. Type your program statement from your coding sheet, in order to set controlling information in the parameter area and to call subroutine.

For example:- We want to set parameters for Drive 'B' diskette, track '10', side '1', sector '5' and read.

```
;
; Example List
;
; Program start

START:                          ;Parameter set
    LXI     H,OFFFOH            ;Parameter area address
    MVI     M,92H               ;5.25", Drive 'B', Side '1'
    INX     H
    MVI     M,10                ;Track 10
    INX     H
    MVI     M,5                 ;Sector 5
    INX     H
    LXX     D,256               ;Transfer bytes count = 256 bytes
    MOV     M,E
    INX     H
    MOV     M,D
    INX     H
    LX1     D,1000H             ;Transfer memory address = 1000H
    MOV     M,E
    INX     H
    MOV     M,D
    INX     H
    MVI     M,2                 ;Retry mode 2
    INX     H
    INX     H
    INX     H
    MVI     M,OFH               ;Command bias = OFH (read mode)
    INX     H
    INX     H
    MVI     M,OFFH              ;Two sided diskette

    CALL    OF503H              ;FDC subroutine call

    JMP     START


    END
```

10. At the end, when you finish input of your program statement, you should press <CTRL> 'Z' key.

You will get ':*' on your CRT.

11. In order to get disconnected from 'ED' and re-boot to system, you should press 'E' key and <RETURN>.

12. Type 'ASM EXAMPLE' and press <RETURN>.
(For detail refer to 'CP/M-80 OPERATING SYSTEM MANUAL'.)

13. Now, if you go back to the directory, you will get your file such as:-

(1) EXAMPLE   BAK (2) EXAMPLE   ASM (3) EXAMPLE   PRN
(4) EXAMPLE   HEX   etc.

14. You need to 'LOAD' command.
(Due previously we made 'HEX' file only now you have to make 'COM FILE' in order to run your program on CP/M-80 Operating System.)

15. Type 'LOAD EXAMPLE' press <RETURN>.

16. In the directory 'EXAMPLE   COM' will appear.

17. If you type 'EXAMPLE' and press <RETURN>, your program will start running automatically.

'End'

---

[11] -7-2 IPL (Initial Program Load)

This program is used only at the system starting to initialize the system I/O controller, loads the system program from the floppy diskette to the main memory. When you call this program, the Formula-l becomes at a initial state through Software-Reset. Usually, there is no need to use this program.

[11]-7-3 FDC (Floppy Disk Control)

Input Parameter : 13 bytes of parameter informations are set in FENT (FDC parameter setting area).

Output Parameter : The status is set in A-register.

Register : All registers are reserved except A-register.

Calling Method : CALL FDC <F503(H)>

This program is the basic instruction to operate 5.25", 8" floppy disk drives. This is operating by setting controlling informations in the parameter area and calling subroutine.

Command Name	Bias	Function
Basic Command	OOH	SEEKZ (Seek to zero track)
Expansion Command	0FH	EREAD (Seek & read data)
	12H	EWRITE (Seek & write data)

Table El : FDC Command

Field	Parameter	Length	Contents
1	Unit No. (UN)	1	D7 D6 D5 D4 D3 D2 D1 D0 #3 #2 #1 #0 Physical unit number Selecting Side {0 ==> Side 0 / 1 ==> Side 1} Unused Selecting Disk Drive {0 ==> 5.25" Disk Drive / 1 ==> 8" Disk Drive} (Note 1) {0 ==> Single density / 1 ==> Double density}
2	Track No. (TK)	1	5.25" : 00H --> 27H 8" : 00H --> 4CH
3	Sector No. (SC)	1	5.25" : 01H --> 12H 8" : 01H --> 1AH
4,5	Byte (BY) Counter	2	Transfer data length (low, high) (Note 2)
6,7	DMA (AD) Address	2	Head address of transfer data (low, high)
8	Retry	1	Retry mode at the error (Note 3) 00H : Non retry 01H : 3 retry (non seek zero) 02H : 3 retry (with seek zero)
9,10	Unused	4	
11	Bias (BS)	1	Bias for each commands (Note 4)
12	Unused	1	
13	Side (SD)	1	Selecting one or two sided diskette 00H : 1 sided diskette FFH : 2 sided diskette

Table 12 : FDC Program Parameter

Note 1 : Double density diskette, "Track 0" in "Side 0" is operating in the same method as of single density diskette. If you select more than one disk drive at the same time, it becomes a unit error.

Note 2 : When using single density diskette the transfer data length is multiple of 128 bytes, that is to say 128 bytes x 1, 128 bytes x 2 or 128 bytes x 3 and so on. And for double density diskette the multiple of 256 bytes. For single density if you set 129, 130 or some other number in between 129 bytes to 255 bytes, then it is automatically being set to 256 bytes. When the transfer data length exceeds the capacity of the last sector of the track, the track number is renewed except for the "Track 0", "Side 0" or the last track.

Note 3 : When you intend to retry executing expansion command, usually always 02H value being designated.

Note 4 : When values of the bias except 3 kinds shown in < Table 11 : FDC Command > are set, it becomes bias error.

Classification	Command Name	Parameter Information (0: set) (x: no set)										
		UN	TK	SC	BY	AD	RY	U1	U2	BS	U3	SD
Basic Command	SEEKZ	o	x	x	x	x	x	x	x	o	x	x
Expansion Command	EREAD	0	0	0	0	0	0	x	x	0	x	0
	EWRITE	o	o	o	o	o	o	x	x	o	x	o

Table 13 : Parameters Setting

This program being executed as a result of setting following status in the accumulator (A-register) and then return to the main program.

Bit Position	Contents of Status	
D0	S0	See following status code list
D1	S1	
D2	S2	
D3	S3	
D4	Error at the executing EREAD command	
D5	Error at the executing EWRITE command	
D6	Zero (Unused)	
D7	Zero (Unused)	

S3	S2	S1	S0	Contents of Error
0	0	0	0	Normal ending of command
0	0	0	1	Normal ending of command. In case of reading data field with deleted data address mark.
0	0	1	0	SEEK ERROR
0	1	0	0	LOST DATA
0	1	1	0	CRC ERROR
1	0	0	0	RECORD NOT FOUND
1	0	1	0	WRITE FAULT
1	1	0	0	WRITE PROTECT
1	1	1	0	DRIVE NOT READY

* There are 9 types of errors as listed in the above table.

Table 14 : Error Status Code List 1

There are following Error Status Code besides the one of previous page.

Error Code	Contents of Error
E0H	Bias Data Error
E1H	Unit Data Error
E2H	DMA Controller Error

Table 15 : Error Status Code List 2

FFFO t 0	Unit Number
FFFO t 1	Track Number
FFFO t 2	Sector Number
FFFO t 3	Number of Transfer Bytes (low)
FFFO t 4	Number of Transfer Bytes (High)
FFFO t 5	Transfer Address (Low)
FFFO t 6	Transfer Address (High)
FFFO t 7	Retry Mode <02(H)>
FFFO t 8	Unused
FFFO t 9	Unused
FFFO t A	Bias for Each Command
FFFO t B	Unused
FFFO t C	Selecting One or Two Sided Diskette

Table 16 : Memory Allocation of FDC Program Parameter

[11]-7-4 CRT (System's CR? Control)

Input Parameter : Set the character code to display into A-register (ASCII code).

Output Parameter : Not exist

Register : All registers are reserved.

Calling Method : CALL CRT <F506(H)>

This is the program to make same function as the extend CRT. By setting a character code to display into A-register and calling this program, you can display character on the CRT. In case of using this program, display speed of serial transferring rate is about 19200 BPS. Direct access is necessary to V-RAM, in case you require fast display speed. See < Table 23 : Video-RAM I/O Map > about the V-RAM address. Moreover, in case of direct access to V-RAM, it is necessary to initialize the address pointer of V-RAM. In this case, call 'CRTINIT <F530(H)>'. So, V-RAM address pointer is initialized, and the screen is cleared.

Below we provide detail information pertaining to system's CRT control codes.

BEL (07H) : Beep the alarm.

BS (08H) : Move the cursor one character to the left side. This control code is invalid if the cursor is on the first position (extreme left) of top of the line.

HT (09H) : Move the cursor to the TAB position of every 8 characters.

LF (0AH) : Operate the line feed.

FF (0CH) : Clear all the screen and move the cursor to first column of the first line.

CR (0DH) : Move the cursor to the top of the line.

SO (0EH) : Set the "Shift-Out" mode. (Note 1)

SI (0FH) : Set the "Shift-In" mode. (Note 2)

DC3 (13H) : Set the mode semi-graphic characters.

DC4 (14H) : Cancel the mode semi-graphic characters. (Initial State)

ESC (1BH) : Set "ESC" sequence mode, for detail refer to 'ESC' Sequence Functions & Code List see next page. (Note 3)

DEL (7FH) : Invalid

2nd Byte	Functions
A (41H)	Moves the cursor up one line.
B (42H)	Moves the cursor down one line.
C (43H)	Moves the cursor right one character.
D (44H)	Moves the cursor left one character.
E (45H)	Clear all the screen.
F (46H)	Ignore the characters over 80 columns/line.
G (47H)	Display those characters in the next line, which exceeds 80 columns/line. (Initial State)
H (48H)	Move the cursor to first column of the first line.
J (4AH)	Erase screen (After Cursor).
K (4BH)	Erase line (After Cursor).
M (4DH)	When cursor at the last line, if this program accept LF code at this time, cursor automatically goes to the first line. Clear screen, and screen does not scroll up even if after accepting LF code.
N (4EH)	Screen scroll up by LF code. (Initial State)
0 (4FH)	Screen scroll up. Cursor does not move.
P (50H)	Screen scroll down. Cursor does not move.
R (52H)	Cursor being not displayed,
S (53H)	Cursor being displayed. (Initial State)
U (55H)	Display test. Indicated "H" all the screen.
Y (59H)	Cursor addressing. (Note 4)
] (5DH)	Print out the contents of the screen. (Note 5)
^ (SEH)	Print out the contents of the full line where the cursor being placed. (Note 5)

Table 17 : ESC Sequence Disposition List

Note **1** : Shift-Out mode, for detail you should refer to
< Table 22 : CRT & Printer Character Code Table (2) >,
where you can add up various different characters for
your specific uses.

For example :- Greek characters, Japanese characters
etc.

Note **2** : Shift-In mode consist of English characters and
symbols at initial state.

Note **3** : In this case, designate cursor address according to
the code of two bytes. In the first byte, line number
being designated and in the second byte, column number.
The next page shows the cursor addressing code.

Note **4** : In case of **the 'ESC'** sequence, if designated byte
numbers are not minimum 2 bytes, which is unacceptable
to program, and therefore the regular display mode
does not return to main program.

Note **5** : Print **out contents** only **from the system's (thermal)**
winter.

Address	Character	Hex Code	Address	Character	Hex Code
1	SPACE	20	21	4	34
2	!	21	22	5	35
3	"	22	23	6	36
4	#	23	24	7	37
5	$	24	25	8	38
6	%	25	26	9	39
7	&	26	27	:	3A
8	'	27	28	;	3B
9	(	28	29	<	3c
10	)	29	30	=	3D
11	*	2A	31	>	3E
12	t	2B	32	?	3F
13	,	2c	33	@	40
14		2D	34	A	41
15	.	2E	35	B	42
16	/	2F	36	C	43
17	0	30	37	D	44
18	1	31	38	E	45
19	2	32	39	F	46
20	3	33	40	G	47

Table 18 : Cursor Addressing Code (1)

Address	Character	HEX Code	Address	Character	HEX code
41	H	48	61	\	5C
42	I	49	62	]	5D
43	J	4A	63	^	5E
44	K	4B	64	_	5F
45	L	4C	65	`	60
46	M	4D	66	a	61
47	N	4E	67	b	62
48	O	4F	68	c	63
49	P	50	69	d	64
50	Q	51	70	e	65
51	R	52	71	f	66
52	S	53	72	g	67
53	T	54	73	h	68
54	U	55	74	i	69
55	V	56	75	j	6A
56	W	57	76	k	5B
57	X	58	77	l	6C
58	Y	59	78	m	6d
59	X	5A	79	n	6E
60	[	5B	80	q	6F

<u>Table 18 : Cursor Addressing Code (2)</u>

[11]-7-5 PRINT (System's Printer Control)

Input Parameter : Set the character code to print into A-register (ASCII code).

Output Parameter : Not exist

Register : All registers are reserved.

Calling Method : CALL PRINT <F509(H)>

Printer is controlled by the software.

The user **can** control the printer as well as printing, only when the user sets the printer code in the accumulator (A-register) and calls this program. At the time of calling this program all registers get reserved:- means at the time of program calling, the inner content of all registers already being reserved and therefore not destroyed.

The program operates buffering of 80 characters, when the characters are over 80 or the device receives the CR <OD(H)> code, the printer starts printing because the printer can not print each and every character.

Below we provide detail information pertaining to **system's** (thermal) printer control codes.

BS (08H) : Cancel the last character before "BS" code. This code is invalid if the position is the top of the line without any character **before it.**

H T (09H): Move the printer's head to the TAB position of every 8 characters.

LF (OAH) : Invalid

FF (OCH) : Move the printer's head to the top of the next **page.**

CR (ODH) : Print one line of buffer content, and carriage return with line feed,

SO (OEH) : Set the Shift-Out mode. (Note 1)

SI (OFH) : Set the Shift-In mode. (Note 2)

DC3 (13H) : Set the mode **semi-graphic** characters.

DC4 (14H) : Cancel the mode semi-graphic characters. (Initial State)

ESC (1BH) : Operate undermentioned operations :-

    <ESC> t 'F' (46H) : Ignore the characters over 80
                        columns/line.

    <ESC> t 'G' (47H) : Print those characters in the next
                        line, which exceeds 80 columns/line.
            ,   (Initial State)

    <ESC> t 'V' (56H) : Print the characters at a interval of
                        one line.

    <ESC> + 'W' (57H) : Print the characters without interval.
                        (Initial State)

  DEL (7FH) : Invalid

Note 1 : Shift-Out mode for detail you should refer to
       < Table 22 : CRT & Printer Character Code Table (2) >,
       where you can add up various different characters for
       your specific uses.

       For example :- Greek characters, Japanese characters
                       etc.

Note 2 : Shift-In mode consist of English characters and
       Symbols at initial state.

---

[11]-7-6 KB (System's Keyboard Control)

  Input Parameter : Not exist

  Output Parameter : The pressed key's code being set in A-register.

  Register   : All registers are reserved except A-register
                   & Flag-register.

  Calling Method   : CALL KB <F50C(H)>

      By calling this program, after keeping key code's into
Accumulator (A-register) and returns back to main program.
All registers except A-register being reserved.

      At the time of calling 'BDOS Function', the key codes of
Function-Keys, Cursor Control-Keys and Numeric-Keys get changed.
For, Function-Keys maximum 8 bytes, and for Cursor Control-Keys
including Numeric-Keys maximum 2 bytes get changed inside the
'BIOS'.

      When you call this program directly the original key codes
< Table 19 : Keyboard Code > of Function-Keys, Cursor Control
-Keys and Numeric-Keys do not change inside the 'BIOS' and
proceed inside the Accumulator (A-register) and returns back to
main program.

---

[11]-7-7 KBSTS (System's Keyboard Status Check)

  Input Parameter : Not exist

  Output Parameter : Without data => A-register = 00(H) (Z=Flag=1)
                     With data   => A-register = FF(H) (Z=Flag=0)

  Register   : All registers are reserved except A-register
                   & Flag-register.

  Calling Method   : CALL KBSTS <F50F(H)>

| RESET | F1 | F2 | F3 | F4 | F5 | F6 | F7 | F8 | F9 | HOME | ↑ | ← | ↓ | → | FEED |

Keyboard layout (1) main section and numeric keypad.

Fig.18 : Keyboard Layout **(1)**

(*1,2) There is no output of key code if you hit this Key.

* 1. The system is reset by means of hitting this key with **'CTRL'**- key.

* 2. The **'FEED'** - key forward the roll paper of the printer.

Fig. 18 : Keyboard Layout (2)

Note : Keys with mode numbers as per

(Table 19 : Keyboard Code - Capstan Lock Off/On)

Mode No	Unshift Sign	Code (HEX)	Shift Sign	Code (HEX)	Control Sign	Code (HEX)	Shift & Control Sign	Code (HEX)
1	1	31	!	21		81		81
2	2	32	"	22		82		82
3	3	33	#	23		83		83
4	4	34	$	24		84		84
5	5	35	%	25		85		85
6	6	36	&	26		86		86
7	7	37	'	27		87		87
8	8	38	(	28		88		88
9	9	39	)	29		89		89
10	0	30	0	30		80		80
11	-	2D	=	3D		8D		8D
12	^	SE	~	7E		1E		1E
13	\	5C	¦	7c		1C		1C
14	BACK SPACE	08	BACK SPACE	08	BACK SPACE	08	BACK SPACE	08
15	q	71	Q	51	DC1	11	DC1	11
16	w	77	W	57	ETB	17	ETB	17
17	e	65	E	45	ENQ	05	ENQ	05
18	r	72	R	52	DC2	12	DC2	12
19	t	74	T	54	DC4	14	DC4	14
20	Y	79	Y	59	EM	19	EM	19
21	u	75	U	55	NAK	15	NAK	15
22	i	69	I	49	HT	09	HT	09
23	o	6F	O	4F	SI	0F	SI	0F
24	P	70	P	50	DLE	10	DLE	10

Table 19 : Keyboard Code – Capstan Lock Off (1)

Mode No	Unshift Sign	Code (HEX)	Shift Sign	Code (HEX)	Control Sign	Code (HEX)	Shift & Control Sign	Code (HEX)
25	@	40	`	60	NULL	00	NULL	00
26	[	5B	{	7B	ESC	1B	ESC	1B
27	_	5F	_	5F		1F		1F
28	LINE FEED	0A	LINE FEED	0A	LINE FEED	0A	LINE FEED	0A
29	CTRL		CTRL		CTRL		CTRL	
30	a	61	A	41	SOH	01	SOH	01
31	s	73	S	53	DC3	13	DC3	13
32	d	64	D	44	EOT	04	EOT	04
33	f	66	F	46	ACK	06	ACK	06
34	g	67	G	47	BEL	07	BEL	07
35	h	68	H	48	BS	08	BS	08
36	j	6A	J	4A	LF	0A	LF	0A
37	k	6B	K	4B	VT	0B	VT	0B
38	1	6C	L	4C	FF	0C	FF	0C
39	;	3B	+	2B		8B		8B
40	:	3A	*	2A		8A		8A
41	]	5D	}	7D		1D		1D
42	RETURN	0D	RETURN	0D	RETURN	0D	RETURN	0D
43	SHIFT		SHIFT		SHIFT		SHIFT	
44	z	7A	Z	5A	SUB	1A	SUB	1A
45	x	78	X	58	CAN	18	CAN	18
46	c	63	C	43	ETX	03	ETX	03
47	v	76	V	56	SYN	16	SYN	16
48	b	62	B	42	STX	02	STX	02

Table 19 : Keyboard Code – Capstan Lock Off (2)

Mode	Unshift		Shift		Control		Shift & Control	
No	Sign	Code (HEX)	Sign	Code (HEX)	Sign	Code (HEX)	Sign	Code (HEX)
49	n	6E	N	4E	SO	0E	SO	0E
50	m	6D	M	4D	CR	0D	CR	0D
51	,	2C	<	3C		8C		8C
52	.	2E	>	3E		8E		8E
53	/	2F	?	3F		8F		8F
54	REPT		REPT		REPT		REPT	
55	SHIFT		SHIFT		SHIFT		SHIFT	
56	H TAB	09	H TAB	09	H TAB	09	H TAB	09
57	CAP LOCK		CAP LOCK		CAP LOCK		CAP LOCK	
58	SPACE	20	SPACE	20	SPACE	20	SPACE	20
59	SHIFT LOCK		SHIFT LOCK		SHIFT LOCK		SHIFT LOCK	
60	DEL	7F	DEL	7F	DEL	7F	DEL	7F
61	ESC	1B	ESC	1B	ESC	1B	ESC	1B
62	+	AA		BA		CA		CA
63	-	AD		BD		CD		CD
64	CL	AB		BB		CB		C B
65	7	A7		B7		C7		C7
66	8	A8		B8		C8		C8
67	9	A9		B9		C9		C9
68	4	A4		B4		C4		c4
69	5	A5		B5		C5		C5
70	6	A6		B6		C6		C 6
71	1	A1		B1		C1		C 1
72	2	A2		B2		c2		c2

Table 19 : Keyboard Code – Capstan Lock Off (3)

-68-

Mode	Unshift		Shift		Control		Shift & Control	
No	Sign	Code (HEX)	Sign	Code (HEX)	Sign	Code (HEX)	Sign	Code (HEX)
73	3	A3		B3		C3		C3
74	0	A0		B0		C0		C0
75	.	AC		BC		CC		CC
76	RESET		RESET		RESET		RESET	
77	F1	91		91		91		91
78	F2	92		92		92		92
79	F3	93		93		93		93
80	F4	94		94		94		94
81	F5	95		95		95		95
82	F6	96		96		96		96
83	F7	97		97		97		97
84	F8	98		98		98		98
85	F9	99		99		99		99
86	HOME	9A		9A		9A		9A
87	→	9B		9B		9B		9B
88	←	9C		9c		9c		9c
89	↑	9D		9D		9D		9D
90	↓	9E		9E		9E	.	9E
91	FEED		FEED		FEED		FEED	

Table 19 : Keyboard Code – Capstan Lock Off (4)

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Mode No	Unshift Sign	Code (HEX)	Shift Sign	Code (HEX)	Control Sign	Code (HEX)	Shift & Control Sign	Code (HEX)
1	1	31	!	21		81		81
2	2	32	"	22		82		82
3	3	33	#	23		83		83
4	4	34	$	24		84		84
5	5	35	%	25		85		85
6	6	36	&	26		86		86
7	7	37	'	27		87		87
8	8	38	(	28		88		88
9	9	39	)	29		89		89
10	0	30	0	30		80		80
11	–	2D	=	3D		8D		8D
12	^	5E	~	7E		1E		1E
13	\	5C	|	7C		1C		1C
14	BACK SPACE	08	BACK SPACE	08	BACK SPACE	08	BACK SPACE	08
15	Q	51	q	71	DC1	11	DC1	11
16	W	57	w	77	ETB	17	ETB	17
17	E	45	e	65	ENQ	05	ENQ	05
18	R	52	r	72	DC2	12	DC2	12
19	T	54	t	74	DC4	14	DC4	14
20	Y	39	y	79	EM	19	EM	19
21	u	55	U	75	NAK	15	NAK	15
22	I	49	i	69	HT	09	HT	09
23	O	4F	o	6F	SI	0F	SI	0F
24	P	50	P	70	DLE	10	DLE	10

Table 19 : Keyboard Code – Capstan Lock On (1)

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Mode No	Unshift Sign	Code (HEX)	Shift Sign	Code (HEX)	Control Sign	Code (HEX)	Shift & Control Sign	Code (HEX)
25	@	40	`	60	NULL	00	NULL	00
26	[	5B	{	7B	ESC	1B	ESC	1B
27	_	5F	_	5F		1F		1F
28	LINE FEED	0A	LINE FEED	0A	LINE FEED	0A	LINE FEED	0A
29	CTRL		CTRL		CTRL		CTRL	
30	A	41	a	61	SOH	01	SOH	01
31	S	53	s	73	DC3	13	DC3	13
32	D	44	d	64	EOT	04	EOT	04
33	F	46	f	66	ACK	06	ACK	06
34	G	47	g	67	BEL	07	BEL	07
35	H	48	h	68	BS	08	BS	08
36	J	4A	j	6A	LF	0A	LF	0A
37	K	4B	k	6 B	VT	0B	VT	0B
38	L	4C	1	6C	FF	0C	FF	0C
40 39	;	3B 3A	*	2B 2A		8B 8A		8B 8A
41	]	5D	}	7D		1D		1D
42	RETURN	0D	RETURN	0D	RETURN	0D	RETURN	0D
43	SHIFT		SHIFT		SHIFT		SHIFT	
44	Z	5A	z	7A	SUB	1A	SUB	1A
45	x	38	x	78	CAN	18	CAN	18
46	C	43	c	63	ETX	03	ETX	03
47	v	56	v	76	SYN	16	SYN	16
48	B	42	b	62	STX	02	STX	02

Table 19 : Keyboard Code – Capstan Lock On (2)

-71-

Mode No	Unshift Sign	Code (HEX)	Shift Sign	Code (HEX)	Control Sign	Code (HEX)	Shift & Control Sign	Code (HEX)
49	N	4E	n	6E	SO	0E	SO	0E
50	M	4D	m	6D	CR	0D	CR	0D
51	,	2C	<	3c		8C		a c
52	.	2E	>	3E		8E		8E
53	/	2F	?	3F		8F		8F
54	REPT		REPT		REPT		R E P T	
35	SHIFT		SHIFT		SHIFT		SHIFT	
56	H TAB	09	H TAB	09	H TAB	09	H TAB	09
57	CAP LOCK		CAP LOCK		CAP LOCK		CAP LOCK	
58	SPACE	20	SPACE	20	SPACE	20	SPACE	20
59	SHIFT LOCK		SHIFT LOCK		SHIFT LOCK		SHIFT LOCK	
60	DEL	7F	DEL	7F	DEL	7F		
61	ESC	1B	ESC	1B	ESC	1B	ESC	1B
62	+	AA		BA		CA		CA
63	-	AD		BD		CD		CD
64	CL	AB		BB		CB		CB
65	7	A7		B7		C7		C7
66	8	A8		Ba		ca		c8
67	9	A9		B9		C9		C9
68	4	A4		B4		c4		c4
69	5	A5		B5		C5		c5
70	6	A6		B6		C6		C6
71	1	A1		B1		C1		C1
72	2	A2		B2		C2		C2

Table 19 : Keyboard Code - Capstan Lock On (3)

Mode No	Unshift Sign	Code (HEX)	Shift Sign	Code (HEX)	Control Sign	Code (HEX)	Shift & Control Sign	Code (HEX)
73	3	A3		B3		C3		C3
74	0	A0		B0		C0		C0
75	.	AC		BC		CC		CC
76	RESET		RESET		RESET		RESET	
77	F1	91		91		91		91
78	F2	92		92		92		92
79	F3	93		93		93		93
80	F4	94		94		94		94
81	F5	95		95		95		95
82	F6	96		96		96		96
83	F7	97		97		97		97
84	F8	98		98		98		98
a5	F9	99		99				99
86	HOME	9A		9A		9A		9A
87	→	9B		9B		9B		9B
88	←	9C		9C		9C		9C
89	↑	9D		9D		9D		9D
90	↓	9E		9E		9E		9E
91	FEED		FEED		FEED		FEED	

Table 19 : Keyboard Code - Capstan Lock On (4)

[11]-7-8 LPRINT '(Centronics Standard Printer Control)

Input Parameter   : Set the character code to print into A-register (ASCII code).

Output Parameter : Not exist

Register   : All, registers are reserved.

Calling Method   : CALL LPRINT ⟨F512(H)⟩

     This is a program to control a external printer with Centronics Standard Printer's Interface connected to Parallel I/O Ports.
For detail refer to the specifications of the connected printer pertaining to it's Function codes.

     Be careful not to call this program without a external printer, otherwise this program cannot return to the CP/M-80.

[11]-7-9 UCRT (RS-232-C Channel-B Data Output)

Input Parameter   : Set a data into A-register which you intend to output from Channel-B.

Output Parameter : Not exist

Register   : All registers are reserved.

Calling Method   : CALL UCRT ⟨F515(H)⟩

     This is a program to output the data from the RS-232-C (Channel-B) Port. The Baud-Rate value being set by the DIP-Switch, which is at the rear side of the Formula-l.
The detail information pertaining to Serial I/O mode and bit format are as follows :-

    Mode   : Asynchronous (Start Stop Synchronous)

    Character Bit Length : 8 bits/character

    Parity   : Even parity

    Stop Bit Length   : 2 stop bit

     In this program control signals such as CS, CD, RS, ER, etc. are not used.
The RS-232-C (Channel-B) being assigned to < TTY > output device when running on CP/M-80.

[11]-7-10 UKB (N-232-C Channel-B Data Input)

Input Parameter   : Not exist

Output Parameter : Set a input data from Channel-B into A-register.

Register   : All registers are reserved expect A-register & Flag-register.

Calling Method   : CALL UKB ⟨F518(H)⟩

     This is a program to input the data from the RS-232-C (Channel-B) Port. The other conditions are the same as those of item < [11]-7-9 UCRT >.

The RS-232-C (Channel-B) being assigned to < TTY > input device when running on CP/M-80.

[11]-7-11 USIOIN (RS-232-C Channel-A Data Input)

Input Parameter   : Not exist

Output Parameter : Set a input data from Channel-A into A-register.

Register   : All registers are reserved except A-register & Flag-register.

Calling Method   : CALL USIOIN ⟨F51B(H)⟩

     This is a program to input the data from the RS-232-C (Channel-A) Port.
The other conditions are the same as those of 'Channel-B' Port.

[11]-7-12 USIOOUT (RS-232-C Channel-A Data Output)

Input Parameter   : Set a data into A-register which you intend to output from Channel-B.

Output Parameter : Not exist

Register   : All registers are reserved.

Calling Method   : CALL USIOOUT ⟨F51E(H)⟩

     This is a program to output the data from the RS-232-C (Channel-A) Port.
The other conditions are the same as those of 'Channel-B' Port.

[11]-7-13 LPRNSTS (Centronics Standard I / F Printer Status Check)

Input Parameter : Not exist

Output Parameter : Busy => A-register = 00(H) (Z-Flag = 0)
Ready => A-register = FF(H) (Z-Flag = 1)

Register : All registers are reserved except A-register
& Flag-register.

Calling Method : CALL LPRNSTS <F521(H)>

  This is the status check program of the Centronics Standard
Interface Printer.

[11]-7-14 UCRTSTS (RS-232-C Channel-B Output Status Check)

Input Parameter : Not exist

Output Parameter : Busy => A-register = 00(H) (Z-Flag = 1)
Ready-> A-register = FF(H) (Z-Flag = 0)

Register : All registers are reserved except A-register
& Flag-register.

Calling Method : CALL UCRTSTS <F524(H)>

  This is a status check program of the output data from
the RS-232-C (Channel-B) port.
This program only checks 'Transfer Buffer Empty' status.

[11]-7-15 UKBSTS (RS-232-C Channel-B Input Status Check)

Input Parameter : Not exist

Output Parameter : Without data => A-register = 00(H) (Z-Flag = 1)
With data => A-register = FF(H) (Z-Flag = 0)

Register : All registers are reserved except A-register
& Flag-register.

Calling Method : CALL UKBSTS <F527(H)>

  This is a status check program of the input data from the
RS-232-C (Channel-B) port. This program only checks 'Receiver
Buffer Ready' status.
The RS-232-C (Channel-B) Input Status being assigned to < TTY >
Input Status when running on CP/M-80.

[11]-7-16 USIOISTS (RS-232-C Channel-A Input Status Check)

Input Parameter : Not exist

Output Parameter : Without data => A-register = 00(H) (Z-Flag = 1)
With Data => A-register = FF(H) (Z-Flag = 0)

Register : All registers are reserved except A-register
& Flag-register.

Calling Method : CALL USIOISTS <F52A(H)>

  This is a status check program of the input data from
the RS-232-C (Channel-A) port.
This program only checks 'Receiver Buffer Ready' status.

[11]-7-17 USIOOSTS (RS-232-C Channel-A Output Status Check)

Input Parameter : Not exist

Output Parameter : Without data => A-register = 00(H) (Z-Flag = 1)
With Data => A-register = FF(H) (Z-Flag = 0)

Register : All registers are reserved except A-register
& Flag-register.

Calling Method : CALL USIOOSTS <F52D(H)>

  This is a status check program of the output data from
the RS-232-C (Channel-A) port.
This program only checks 'Transfer Buffer Empty' status.

[11]-7-18 CRTINIT (System's CRT Initialize)

Input Parameter : Not exist

Output Parameter : Not exist

Register : All registers are reserved.

Calling Method : CALL CRTINIT <F530(H)>

  This is a program to initialize system's CRT.
By calling this program V-RAM address pointer get initialized
and moves to first address position of the V-RAM, and thereafter
screen get cleared.

[11]-8 System Utility Program's

This utility program consists of 'FORMAT', 'FSYSGEN', 'SYSTEM', 'PROMW' and 'FUNC' commands has been made by our company and supplied to our users as transient command.

[11]-8-1 FORMAT : Command for diskette format

The object of this command is to create a new index on the new or old diskette in order to proceed for using with our computer.

Usually, new diskette can not be read and impossible to write on it, without formatting.

Time to time, if diskette being damaged due to unusual handling, strong electric and magnetic forces then we need to do the formatting.

You should be very careful when executing this program, because the contents of the diskette will get erased as this process is over. The operations are as follows.

A>FORMAT   <RETURN>

*** Diskette formatting **(Vers. *.*) *****
Drive name **? A,B,C,D,E,F,G,H (or** RETURN **to reboot):**

In this state, set the diskette to record a format into the floppy disk drive and input the same disk drive's name and press <RETURN> **key.**
The name of the disk drives as stated above are the same as of **CP/M-80,** and details are as follows.

Drive **A :** 5.25' two-sided double density

Drive B **:** 5.25' two-sided double density

Drive C **:** 5.25" two-sided double density

Drive D **:** 5.25' two-sided double density

Drive **E :** 8" one-sided single density

Drive F **:** 8" one-sided single density

Drive G **:** 8" two-sided double density

Drive H **:** 8" two-sided double density

After you input the name of the disk drive in use, following message will appear on your CRT.

Formatting track address ?   A. All tracks **00-**** Track:

When you intend to format all the tracks of the diskette, type 'A' key and press <RETURN>.

Further, if you intend to format one track only, then you should type the specific track number to be formatted and press <RETURN> key, following message will appear on your CRT.

Formatting start ? (Y/N)

In order to start formatting, press **'Y'** key.
If the process of formatting ends without any error the process complete message will appear on your CRT, and gets back to initial state.

If you do not wish to start or intend to return to initial state press 'N' key only.

Further, during the process of formatting if there being an error, the following error message will appear on your CRT, and gets back. to initial state.

Formatting start
Read check start
Process complete --------------- **Normal end**
(Disk write **error !!!**) ---------- Abnormal end (I)
(Disk read error **!!!**) --------- Abnormal end (II)

Abnormal end (I)   **:** The diskette is not inserted properly, unlocked or in a state of write-protect.

Abnormal end (II) **:** When after recording the format, the data in the diskette are impossible to be read correctly.

We have shown the procedure of formatting a new diskette on the following **page.**

```
*** 60K CP/M Vers. 2.2 Formula-l System ***
BIOS Created By YCU Co., Ltd. (1983.**.**)
A>FORMAT

*** Diskette formatting (Vers. *.*) ***
Drive name ?  A,B,C,D,E,F,G,H (or RETURN to reboot):

    ----------------------------
    ----------------------------

Process complete !
```

Fig. 19 : FORMAT Message

PROCEDURE OF 'FORMAT' A NEW DISKETTE:-

A new diskette, we mean a 'new blank diskette'.

1. Formula-l power switch ON.

2. Insert the CP/M-80 SYSTEM DISKETTE into Drive 'A'
    and lock.

3. Insert a new diskette (to be formatted) into Drive 'B'
    and lock.

4. After displaying prompt = 'A>'.

    Type 'FORMAT' press <RETURN>.

5. Now, you will find computer asking for

    Drive name ? A,B,C,D,E,F,G,H, (or RETURN to reboot):

    Type 'B' and press <RETURN>.

6. Displaying

    Formatting track address ? A. All tracks 00-39 track:

    Type 'A' and press '<RETURN>.
    (For detail refer to Note 1)

7. After displaying

    Formatting start ? (Y/N)

    Press 'Y' for Yes.

    Formatting start
    Read check start

    Process complete !

    This is the end of formatting of a new diskette.
    (In order to continue formatting more diskettes, please
    refer to Note 2)

8. For finishing this process.
    Press <RETURN> in order to reboot.

Note 1 : 1) When using Disk Drive A, B, C and D 5.25"
             diskettes the track numbers will be from 00 to
             39 due 40 tracks available for formatting. If
             you intend to format track 5 only then input 5
             and press <RETURN>. If you intend to format
             5, 6 and 7 tracks, then you have to input and
             'FORMAT' each track number one-by-one separately.
             This means that you can format only one track
             at a time except for A. All tracks.

          2) When using Disk Drive E, F, G and H 8" diskettes,
             the track numbers will be from 00 to 76 due 77
             tracks available for formatting.
             Rest is same as above.

Note 2 : If you intend to continue 'Formatting' more
          diskettes, just unlock Drive 'B' and insert again a
          new diskette and lock, follow our instruction from
          5.

[11]-8-2 FSYSGEN : Command for system generation

This command **is** same as 'SYSGEN' of transient command of the **CP/M-80**, modified to Formula-1. See **CP/M-80** manual for method of operation.

The object 'FSYSGEN' is to copy 'CCP', 'BDOS', 'BIOS' which are inside the system tracks of source drive diskette to the destination drive diskette.

```
*** 60K CP/M Vers. 2.2 Formula-1 System ***
BIOS Created By YCU Co., Ltd. (1983.**.**)
A>FSYSGEN

SYSCEN VERSION *.*

SOURCE DRIVE NAME (OR RETURN TO SKIP)
```

Fig. 20 **:** FSYSGEN Message

PROCEDURE OF 'FSYSGEN' A NEW **DISKETTE:-**

You should 'FSYSGEN' a new diskette, which you have already 'FORMATTED' before.

1. Insert the **CP/M-80** SYSTEM DISKETTE into Drive **'A'** and lock.

2. Insert 'FORMATTED' diskette into Drive 'B' and lock.

3. Type 'FSYSGEN' and press <RETURN>.
   (When displaying prompt ≈ 'A>').

4. Displaying

   SYSGEN VERSION *.*

   SOURCE DRIVE NAME (OR RETURN TO SKIP)

5. Type source drive name as 'A' and press <RETURN>.
   (You can use any one of the following drives name
   'A', 'B', 'C', 'D')

6. You will get following message on your CRT.

   SOURCE ON **A** THEN TYPE RETURN

7. Press <RETURN>.
   You will get following message on your CRT.

   FUNCTION COMPLETE

   This means process of reading from source diskette being completed.

8. You will get following message on your CRT.

   DESTINATION DRIVE NAME (OR RETURN TO REBOOT)

9. Type destination drive name as **'B'** and press <RETURN>.
   (You can use any one of the following drives name
   'A', 'B', 'C', 'D')

10. Following message will appear on your CRT.

    DESTINATION ON B THEN TYPE RETURN

11. Press <RETURN>.
    You will get following message on your CRT.

    FUNCTION COMPLETE

    This means process of writing to the destination diskette being completed.

12. If you input wrong drive name, an error message will appear on your CRT.

    not implement drive name **!!!**

    In order to proceed further, you should go back to item 4.

13. In order to reboot. You should get the following message on your CRT.

SOURCE DRIVE NAME (OR RETURN TO SKIP)

Now press <RETURN>.
Displaying following.

DESTINATION DRIVE NAME (OR RETURN TO REBOOT)

Press <RETURN> to reboot. You will **get** prompt 'A>'.

Note 1 : Important:
At first you should 'FORMAT' a new diskette then proceed for 'FSYSGEN' the same.

When using **8"** disk drives and diskettes, the process of 'FSYSGEN' is not required. Therefore you should **not** 'FSYSGEN' 8" diskettes, just 'FORMAT' and start using them according to your choice.

Note 2 : If you intend to continue 'FSYSGEN' more diskette, just unlock Drive **'B'** and insert again a new previously formatted diskette **&** lock, and follow our instruction from 4.

[11]-8-3 SYSTEM : Command for system generation

The object of 'SYSTEM' is to **generate** 'CCP', 'BDOS', 'BIOS' into the system tracks of the destination disk drive diskette. While executing this 'SYSTEM' command program, you should note that the directory of the diskette never gets damage.

The operations are as follows.

A>SYSTEM   <RETURN>

CP/M Vers. 2.2 System generation (for Formula-l)
Destinat'ion drive name **A,B,C,D** (or RETURN to reboot):

In the above state, insert a new diskette into other drive and lock. Now, input the name of the disk drive in which **you** have inserted the new.diskette and press <RETURN>..

Due 5.25" diskettes being loaded by IPL, therefore we only need to do 'SYSTEM' of 5.25" diskettes and not 8" diskettes. Accordingly, you should have to choose one of the disk drives name from the following 'A,B,C,D' in order to use.

After you input the disk drive's name, the following message will appear on your CRT.

Generation Start **?** (Y/N)

If you intend to generate the 'SYSTEM' on the diskette, press **'Y'** then generation start automatically.
If the process completes correctly, the following message will appear on your CRT, as 'Process complete' and return to initial state.

If there being an error, the error message will appear on your CRT as 'Disk write error **!!!'**, and return to initial state.

When you do not intend to use this program of system generation, press 'N', the execution stops and returns back to **CP/M-80** Operating System.

Process complete ------------ **Normal end**
(Disk write error I!!) ------ Abnormal end

We have shown the procedure of 'SYSTEM' a new diskette on the following page.

```
*** 60K CP/M Vers. 2.2 Formula-l System ***
BIOS Created By YCU Co., Ltd. (1983.**.**)
A>SYSTEM

CP/M Vers. 2.2 System generation (for Formula-l)
Destination drive name A,B,C,D (or RETURN to reboot):

  -------------------------------
  -------------------------------

Process complete !
```

Fig. 21 : SYSTEM Message

PROCEDURE OF 'SYSTEM' A NEW DISKETTE:-

In order to generate 'SYSTEM' on a new diskette, which you
have already 'FORMATTED' before.

1. Insert the CP/M-80 SYSTEM DISKETTE into Drive 'A'
    and lock.

2. Insert 'FORMATTED' diskette into Drive 'B'
    and lock.

3. Type 'SYSTEM' and Press <RETURN>.
    (When displaying prompt = 'A>').

4. Displaying

    Destination drive name A,B,C,D, (or RETURN to reboot):

    Press 'B'.

5. After displaying

    Generation Start ? (Y/N)

    Press 'Y' for Yes.

    Generation starts and completes automatically
    following message appears:-

    Process Complete !

    (In order to continue 'SYSTEM' more diskettes please
    refer to Note 2)

6. Press <RETURN> in order to reboot.

Note 1 : Important: .
          At first you should 'FORMAT' a new diskette then
          proceed for 'SYSTEM' the same.

          When using 8" disk drive and diskettes, process of
          'SYSTEM' is not required. Therefore you should not
          'SYSTEM' 8" diskettes, just 'FORMAT' and start
          using them according to your choice.

Note 2 : If you intend to continue 'SYSTEM' more diskette,
          just unlock Drive 'B' and insert again a new
          previously formatted diskette & lock, and follow
          our instruction from 4.

[11]-8-4 PROMW : Command for EP-ROM programmer

It is possible to write-in and read-out the following EP-ROM, by using 'PROMW' command program based on the CP/M-80 Operating System.

When using EP-ROM 2716 / 2516, 2732, 2532 and 2764, you should adjust the slide switch on the right side of EP-ROM socket UP or DOWN, according to specific EP-ROM, you intend to use.

```
2716 / 2516, 2732 & 2532 -------------- switch UP
2764 -------------------------------- switch DOWN
```

(1) 2716 (Intel)
    2516 (TI)

(2) 2732 (Intel)

(3) 2532 (TI)

(4) 2764 (Intel)

This program executes under the control of the CP/M-80 in conversational style, it is possible to write-in, read-out, erase check, etc.
There are total 13 kinds of commands available herewith.

Now you should get command menu. This program is in the CP/M-80 system diskette, therefore:-

1. Insert the CP/M-80 SYSTEM DISKETTE into Drive 'A' and lock.

2. Now you will get prompt 'A>' on your CRT.

    Type 'PROMW' and press <RETURN>.
    You will get following command menu.

```
A>PROMW      <RETURN>


Formula-l EP-ROM Programmer (Vets. *.*)


****** B-2716/2516, C-2732, D-2532, E-2764 ******

**** Command Menu ****
 CM : Compare Memory To EP-ROM
 CP : Copy EP-ROM To EP-ROM
 DP : Memory Dump
 DT : Display Command Menu
 EC : Erase Check To EP-ROM
 LR : Linking Read. From EP-ROM To Memory
 MC : Memory Change
 MF : Make CP/M Hexa File (EP-ROM)
 MM : Make CP/M Hexa File (Memory)
 RD : Read From EP-ROM To Memory
 RF : Read From CP/M Hexa File To Memory
 RT : Return To CP/M
 WM : Write From Memory To EP-ROM

P]
```

Fig. 22 : EP-ROM Command Menu

'P]' appears on the CRT, and stand by for key-input. The following shows an input format of each command.

Usually, more than one parameter being required to operate each command as mentioned in the command menu.

Further, in between a command and 1st parameter, 2nd parameter and 3rd parameter, it is necessary to have a ',' or more than one space in order to operate these commands.

[Command name] [1st Parameter] [2nd Parameter] [3rd Parameter] <RETURN>

PROCEDURE OF OPERATING EP-ROM COMMANDS

1. CM: Compare Memory To EP-ROM

     This command compares the contents of the EP-ROM
with the contents of the designated memory.
If the consequence is correct, 'OK' appears and if the
consequence is not correct, 'ERROR' appears.

The following explains an input format of the command.

[CM] [A type of EP-ROM] [Address of compare starting] <RETURN>
(1)   (2)   (3)

(1) :   Command name : CM

(2) :   B-2716/2516 (Intel or TI)
        C-2732 (Intel)
        D-2532 (TI)
        E-2764 (Intel)

(3) : Hexa 4 characters

P]CM B 3000   <RETURN>

COMPARE 2716
ADDRESS 3000
SET PROM ON THE SOCKET OK ? THEN HIT ANY KEY

     If the EP-ROM is set on the socket correctly, this
command starts immediately after hitting any key, and the
consequence appears.

COMPARE TO 37FF
OK !!
P]

or

COMPARE TO 37FF
ERROR !!
P]

2. CP: Copy EP-ROM To EP-ROM

     By this command, the contents of the designated EP-ROM
are copied to the other designated EP-ROM.
However, you should note that only the same type of the
EP-ROM can be copied.
The following explains an input format of this command.

[CP]   [A Type of EP-ROM]   <RETURN>
(1)   (2)

(1) : Command name : CP

(2) : B, C, D or E

P]CP c   <RETURN>

COPY 2732
SET PROM ON THE SOCKET OK ? THEN HIT ANY KEY

     By pressing any key, at first the contents of the
EP-ROM set now on the EP-ROM socket are read, and the
following message appears.

READ OK (COPY) !!
SET PROM ON THE SOCKET OK ? THEN HIT ANY KEY

     Take away the currently set EP-ROM from socket, set
the new EP-ROM, and hit any key.

OFFF 00 ----- Writing address and data
O K !!
P]

or

OFFF 00 ----- Writing address and data
ERROR !!
P]

     After ending to write, automatically the contents of
the written EP-ROM is compared with the contents of the
memory, and the consequence appears.

3. DP: Memory Dump

[DP]   [Start Address]   [End address]   <RETURN>
 (1)   (2)   (3)

(1) : **Command name :** DP

(2) : **Hexa** 4 characters

(3) : **Hexa** 4 characters

P]DP 3000 3050   <RETURN>

```
3000 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
3010 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
3020 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
3030 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
3040 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
3050 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
```

4. DT: Display Command Menu

     This command display EP-ROM command menu on your CRT.
The input format of this command are as follows.

[DT]   <RETURN>   <No Parameter>
(1)

(1) : Command name : DT

****** B-2716, C-2732, **D=2532,** E-2764 ******

**** Command Menu ****
 CM : Compare Memory To EP-ROM
 CP : Copy EP-ROM To EP-ROM
 DP : Memory Dump
 DT : Display Command Menu
 EC : Erase Check To EP-ROM
 LR : **Linking** Read From EP-ROM To Memory
 MC : Memory Change
 MF : Make **CP/M Hexa** File (EP-ROM)
 MM : Make **CP/M Hexa** File (Memory)
 RD : Read From EP-ROM To Memory
 RF : Read From CP/M Hexa File To Memory

5. EC: Erase Check To EP-ROM

     This command checks whether the contents of the
EP-ROM has been erased or not.
The following explains an input format of the command.

[EC]   [EP-ROM Type]   <RETURN>
(1)   (2)

(1) : Command name : EC

(2) : B, C, D or E

P]EC D   <RETURN>

ERASE CK 2532
SET PROM ON THE SOCKET OK ? THEN HIT ANY KEY

     Then, if the EP-ROM is set correctly, hit any key.
So the consequence (result) appears.

ERASED OK !!
P]

or

NOT ERASED !!
P]

6. LR: Linking Read from EP-ROM To Memory

    By this command, the contents of the EP-ROM are read in order, and stored in the memory. Before execution of the command, it is necessary to execute 'RD' command. The input format of this command is as follows.

[LR]   [EP-ROM Type]   <RETURN>
(1)   (2)

(1) : Command name : LR

(2) : B, C, D or E

P]LR B   <RETURN>

READ 2716
ADDRESS 3800
SET PROM ON THE SOCKET OK ? THEN HIT ANY KEY

    After you have set the EP-ROM correctly, hit any key. So, the contents of the EP-ROM are loaded to the next address of the previous contents read before.

DATA IS STORED FROM 3800 TO 3FFF
P]LR B   <RETURN>

READ 2716
ADDRESS 4000
SET PROM ON THE SOCKET OK ? THEN HIT ANY KEY

7. MC: Memory Change

    This command being used when changing the contents of the memory.
The following explains an input **format of the command.**

[MC]   [Memory Address]   <RETURN>
(1)   (2)

(1) : Command name : MC

(2) : Hexa 4 characters

```
P]MC 4000     <RETURN>
4000 00 55    <RETURN>     -----  55 : A changing data
4001 00       <RETURN>     Address increment
4002 00       <RETURN>
4003 00 -     <RETURN>
4002 00 -     <RETURN>     Address decrement
4001 00 -     <RETURN>
4000 55 /     <RETURN>     -----  / : Return command
```

    When you press <RETURN> key only, this command will display the next forward address. However, if you press '-' key and then press <RETURN> key.
This command will display the preceding address.

8. MF: Make CP/M Hexa File (EP-ROM)

    This command makes the CP/M Hexa File by a format of < File Name.HEX > and saves the contents of the EP-ROM. And before executing this program, it is necessary to execute 'RD' , 'LR' commands.
Input format of the commands is as follows.

[MF]   [Drive Name : File Name]   <RETURN> .
(1)   (2)

(1) : Command name : MF

(2) : Drive name --- A-H
             (If you omit or forget to input the drive name, then automatically the drive's name currently in use get selected.)

      File name --- English figures and codes
             (Maximum of 8 figures, file type will be fixed to 'HEX'.)

P]MF B:TEST   <RETURN>

MAKE FILE TEST DRIVE B   FROM 3000 TO 4000
FILE TYPE IS HEX ALL INFORMATION   OK **?**
IF NO GOOD   THEN   **_HIT_ "N"** KEY **! !**

     If the contents "displayed on your CRT are correct,
then hit any key except 'N' key, in order to make the file.

P]

9.   MM: Make File **CP/M Hexa** File (Memory)

     This command makes the **CP/M Hexa** File by a format
of < File Name.HEX > and saves the contents of the memory.
The following explains an input format of the command.

[MM] [Dv. **Name:File** Name] [Start Adre.] [End Adre.] <RETURN>
(1)   **(2)**   (3)   **(4)**

(1) : Command name **:** MM

(2) : Drive name --- **A-H**
           (If you omit or forget to input the
           drive name, then automatically the
           drive's name currently in use get
           selected.)

      File name --- English figures and codes
                  (Maximum of 8 figures, file type will
                   be fixed to 'HEX'.)

P]MM TEST 3000 4000   <RETURN>

MAKE   FILE TEST DRIVE **A**   FROM 3000 TO 4000
FILE TYPE IS HEX   ALL   INFORMATION OK ?
IF NO GOOD THEN HIT **"N"** KEY **! !**

     If the contents displayed on your CRT are correct,
then hit any key except **'N'** key, in order to make the file.

P]

10.   RD: Read From EP-ROM To Memory

     This command simultaneously reads the contents of the
EP-ROM and loads it into the designated memory address.
The input format of this command is as follows.

[RD]   **[** EP-ROM Type]   [Start Address **]** <RETURN>
(1)   **(2)**   **(3)**

(1) : Command name **:** RD

(2) : B, **C,** D or E

(3) : Hexa 4 characters

P]RD B 5000   <RETURN>

READ 2716
ADDRESS 5000
SET PROM ON THE SOCKET OK ? THEN HIT ANY   KEY

     If the EP-ROM is set correctly, hit any key in
order to start and complete this process.

DATA IS STORED FROM 5000 TO **57FF**
P]

11.   RF: Read From **CP/M** Mexa File To Memory

     This command reads the contents of the 'HEX' or 'COM'
file of the **CP/M-80** and loads it to memory.
Further at the time of loading, it is possible to add the
bias value to the loading address too.
The input format of this command is as follows.

[RF] [Drive Name:File Name.File **Type**] [Bias Value] <RETURN>
(1)   **(2)**   **(3)**

(1) : Command name **:** RF

(2) : Drive name --- A-H
           (If you omit or forget to input the
           drive name, then automatically the
           drive's name currently in use get
           selected.)

      File name   --- English figures and **_codes_**
                  (Maximum of 8 figures.)

      File type   --- Either 'HEX' or 'COM'

(3) : Hexe 4 characters   If you omit or forget to input
the **hexa** 4 characters, then
automatically bias value turns
into '0000'.

P]RF A:TEST.HEX **1000**   <RETURN>   (at **ORG =** 4000H)

READ **CP/M** FILE (HEX OR COM)
DATA IS STORED FROM **5000** TO 6000
P]

After pressing <RETURN> key, the process starts
and completes the file contents being read and get
loaded immediately into the assigned memory address.

12.   RT: **CP/M-80** Return

By **'RT'** command you can return back to the **CP/M-80**
from EP-ROM programmer.
This command works same as pressing **<CTRL>** 'C' key.
The following explains an input format of the command.

[RT]   <RETURN>   <No Parameter>

For this command parameter is not required.

13.   WM: Write From Memory To EP-ROM

The **'WM'** command write the contents of the designated
memory address to the EP-ROM. After finish writing, the
process of read **&** compare-check automatically being done
by this command and thereafter consequence (result) appears.
You should note that the erase-check has not been done at
this time of writing.

If error occurs in the process of writing, this
command rewrites again automatically.

In order to stop writing on the way, press 'S' key,
to finish writing press **'N'** key, and at this state the
process compare-check does not take place.

In order to continue writing **again** press **'Y'** key.
The writing address and the related data will always
appear on your CRT at time of writing.
The input format of this command are as follows.

[WM]   [EP-ROM Type]   [Start Address]   <RETURN>
(1)   **(2)**   **(3)**

(1) : Command name **:** WM

(2) : B, C, D or E

(3) : Hexa 4 characters

P]WM B 3000   <RETURN>

WRITE   2716
ADDRESS 3000
SET PROM ON THE SOCKET OK **?** THEN HIT ANY KEY

If the EP-ROM is set correctly, hit any key in order
to start this process and you will get following message
on your CRT.

07FF 0 0 ----- Writing address **&** data
DATA IS WRITTEN TO 37FF
O K **!!**
P]

or

07FF 00 ----- Writing address **&** data
DATA IS WRITTEN TO 37FF
ERROR **!!**
P]

Now if you get above error message on your CRT,
then you should replace the EP-ROM with the new one
and try again from the beginning.

[11]-8-5 FUNC : Command for function a numeric-keys

This command can change the code of Function-Keys, Numeric-Keys and Cursor Control-Keys on the CP/M-80 basis. Every Function-Keys codes, which can be assigned by this command are limited to 8 bytes, and every Numeric-Keys and Cursor Control-Keys codes are limited to 2 bytes. Next, the operation is explained.

```
Function' Key Code Change Command (Vers. *.*)
            (c)1982,YCU CO., LTD.

F1              91 00 00 00 00 00 00 00
F2              92 00 00 00 00 00 00 00
F3              93 00 00 00 00 00 00 00
F4              94 00 00 00 00 00 00 00
F5              95 00 00 00 00 00 00 00
F6              96 00 00 00 00 00 00 00
F7              97 00 00 00 00 00 00 00
F8              98 00 00 00 00 00 00 00
F9              99 00 00 00 00 00 00 00

HOME   H  1B 48      →    C  1B 43    ←    D  1B 44
  ↑    A  1B 41      ↓    B  1B 42    0  0  30 00
  1    1  31 00      2  2  32 00      3  3  33 00
  4    4  34 00      5  5  33 00      6  6  36 00
  7    7  37 00      8  8  38 00      8  9  38 00
  +    +  2B 00      CL    oc 00      .  .  2E 00
  -    -  2D 00

*
```

Fig. 23 : Function-Keys Code Table

PROCEDURE OF SETTING FUNCTION-KEYS CODE

Detail explanation of Function-Keys and their code change commands, including setting of Function-Keys are as follows:-

1. Insert CP/M-80 System Program into Drive 'A'.

2. You will get prompt 'A>' on your CRT.

3. Type 'DIR' press <RETURN> Key.
   (to get the directory of the CP/M-80)'

4. Now, you check in the directory for Function-Keys codes change command as 'FUNC   COM'.

5. Type 'FUNC' press <RETURN> key.

6. You will get above message on your CRT (Fig. 23).

There are four different types of command in order to change Function-Keys code:-

(1) ASCII code input command

(2) Hexa code input command

(3) Function-Keys code display command

(4) Disk write and exit command

1. ASCII code input command

If you intend to change key code of any one of the Function-Keys, Numeric-Keys or Cursor Control-Keys at the beginning, you should press the specific key which you want to change.

For example:- If you want to change 'F2' key code, press 'F2' key

```
*F2
F2              92 00 00 00 00 00 00 00
```

Now type your intended key code you want to set into 'F2' Function-Keys code. If you want to input "STAT's" code into the code of 'F2' Function-Keys.

Then type "STAT" and press <RETURN> key. You will find "STAT" code being inserted into 'F2' code area.

```
*F2
F2              92 00 00 00 00 00 00 00
     STAT       <RETURN>
F2   STAT       53 54 41 54 00 00 00 00
*
```

You will get "STAT's" ASCII code being input into the 'F2' key's Hexa code area. The previously inserted code, ' if any automatically get erased.

Every Function-Keys code which can be assigned by this command are limited to maximum 8 bytes, every Numeric-Keys code and Cursor Control-Keys code are limited to maximum 2 bytes.

If you make any input errors, you can erase by pressing 'BACK SPACE' key. Therefore you can erase unwanted input immediately.

Note 1 : If you input more than 8 bytes for Function-Keys and more than 2 bytes for Numeric-Keys and Cursor Control-Keys then you will get 'Input Parameter Error !!!'. Therefore, re-input again correctly to proceed further.

Note 2 : You can also input less than 8 bytes for Function-Keys and less than 2 bytes for Numeric-Keys and Cursor Control-Keys and at the end, in order·to finish press <RETURN> key.

2. Hexa code input command

By changing the Function-Key code to the optional codes, at the beginning press 'H' key, so '#' character appears, and press the key which is going to be changed. Now you should remember you can input key codes from '0' to '9' and from 'A' to 'F' only. Due other key codes are not Hexa code therefore unable to operate with this command.

For example:- If you want to change 'F2' key code to 'STAT <RETURN>' at first press 'H', you will get '#' on your CRT.

```
*H
#
```

Press 'F2' key, following appears:-

```
#F2
F2     STAT        53 54 41 54 00 00 00 00
```

Now input Hexa code character for 'STAT <RETURN>' (5354415 40D) and press <RETURN>.

```
F2     STAT        53 54 41 54 00 00 00 00
                   53 34 41 54 OD              <RETURN>
F2     STAT        53 54 41 54 OD 00 00 00
*
```

Thus the change of codes being completed.

If you do any mistake in input characters into Hexa code, then you can not erase it with 'BACK SPACE' key. In order to start again, you should go to the beginning. Therefore press <RETURN> key. Try again.

You should always input 2 characters code at a time. You can only input your character code into Function-Keys code, Numeric-Keys code and Cursor Control-Keys code. If you input some other key code, you will get 'Parameter Error !!!'.

Note 1 : If you input more than 8 bytes for Function-Keys and more than 2 bytes for Numeric-Keys and Cursor Control-Keys, then you won't get any 'Input parameter error !!!' sign.

Note 2 : In order to stop or change, press <RETURN> key,

3. Function-Keys code display command

In order to operate this command, at first you should press 'D' key to get Function-Keys code display table as follows:-

```
*
F1            91 00 00 00 00 00 00 00
F2   STAT     53 54 41 54 OD 00 00 00
F3            93 00 00 00 00 00 00 00
F4            94 00 00 00 00 00 00 00
F5     .      95 00 00 00 00 00 00 00
F6            96 00 00 00 00 00 00 00
F7            97 00 00 00 00 00 00 00
F8            98 00 00 00 00 00 00 00
F9            99 00 00 00 00 00 00 00

HOME   H  1B 48    →   c  1B 43    ←   D  1B 44
↑      A  1B 41    ↓   B  1B 42    0   0  30 00
1      1  31 00    2   2  32 00    3   3  33 00
4      4  34 00    5   5  35 00    6   6  36 00
7      7  37 00    8   8  38 00    8   9  38 00
+      +  2B 00    CL     oc 00    .   .  2E 00
       -  2D 00

*
```

Upon operating display command, above Function-Keys code table will appear on your CRT and represent codes of Function-Keys, Numeric-Keys and Cursor Control-Keys.

4. Disk write and exit

Due the codes which have already been changed to new one will get erased automatically after System-Reset. Therefore, if you want to restore new (changed) codes, then, you have to write on the system diskette. In order to write, you must appoint disk drive 'A' as main drive. Press 'E' key, you will get following message on your CRT.

Disk Write Ok (Y/N) ?

If you change your mind and do not want to write/restore on the diskette (Drive 'A'), press 'N' key. So it will return *back to the CP/M-80 from this command, and 'Re-boot !!!' message will appear on your CRT.

If you intend to write into your diskette (Drive 'A'), then press 'Y' key. On normal end the following message appears.

Disk Write Complete !!

And system automatically returns back to initial state of 'Disk Write Ok (Y/N) 2'.

5. CP/M-80 return

When you want to get out of this command and return to the CP/M-80, press <CTRL> 'C' key.

6. Errors

1) Parameter Error !!!
If you input any key other than Function-Keys, Numeric-Keys and Cursor Control-Keys as well as 'H', 'D', 'E' keys you will get 'Parameter Error !!!'.

2) Input Parameter Error !!!
Input characters number is over.
This means if you input more than 8 bytes for Function-Keys and more than 2 bytes for Numeric-Keys and Cursor Control-Keys, then you will get 'Input Parameter Error !!!'.

3) Read Error !!!
When diskette (Drive 'A') being damaged.
Therefore it is impossible to read-out from diskette (Drive 'A'), and also it is impossible to write into the diskette (Drive 'A').

4) Write Error !!!
It is impossible to write into the diskette (Drive 'A'). Due to diskette has damages or protection label being pasted on it, and it will 'Re-boot' automatically.

5) Writing to diskette is Impossible !!!
When there is a 'Read Error' and you intend to write on the diskette (Drive 'A'), the above message appears and it will 'Re-boot' automatically.

[12] Inside of the Formula-l

[12]-1 General Specifications of Z80A Family Chips

You can use the Formula-l's Z80A family chips according to your specific requirement **also.** Therefore, you should read 'I/O Map' and 'The Specifications of Z80A Family Chips' in order to use them for **your specific** purposes.

Serial **I/O**   (Z80A SIO)

Parallel I/O   (Z80A PIO)

Counter **&** Timer   (Z80A CTC)

DMA   (Z80A DMA)

In order to **use** the above devices, at first, you must initialize **the** chips. I/O device address of the Formula-l **is** composed of 16 bits, and we have arranged the V-RAM of CRT in the I/O area such a way that you can use all **64K** bytes memory area as your program area. Further in this, when accessing I/O device the instructions of 'IN' and 'OUT' are limited to the following data Input/Output instructions.

Data input instruction

IN   A,(C)   ;BC-register **:** Device **address**

Data output **instruction**

OUT (C),A   ;BC-register **:** **Device address**

[12]-1-1 Serial I/O (Z80A SIO)

As per our standard, we have set the parameters in asynchronous mode for both **Channel-A and Channel-B.**

Mode	Asynchronous **(Start** Stop **Synchronous)**
Interrupt	Disable
Character Bit Length	**8 bits/character**
Parity	Even number parity
Stop Bit Length	2 stop bit
Clock Rate	x 16
Remarks	**As** per our **standard, we are using control signals 'RD' and 'SD' only.**

Please note, if you intend to **use** any other mode. Kindly see **the** item **No. <** [6]-4 RS-232-C Interface > and Serial I/O (Z80A SIO) chip's manual and 'I/O Map' thoroughly, as well as initialize Serial I/O again,

We can set Baud-Rate clock in two **ways:-**

1. By using 'Baud-Rate Selection Switches'
   The Baud--Rate clock usually being formed and set in Z80A CTC, by **setting** corresponding values according to < Table 9 : **Baud-**Rate Setting > with the help of 'Baud-Rate Selection Switches' in the DIP-Switch, which is at the rear side of Formula-l,

2. By using 'Clock-Rate Selection Switches'
   In this procedure, you can directly set corresponding **Baud-**Rate values into Z80A CTC, by changing **the** position of 'x 1' and 'x 16' 'Clock-Rate Selection Switches' according to < Table 20 **:** CTC Setting List > in **the** DIP-Switch.

In order to set Baud-Rate value CTC Setting List as **follows:-**

Z80A CTC Setting	Baud Rate Setting	
	x 1	x 16
1	38400	19200
2	19200	9600
4	9600	4800
8	4800	2400
16	2400	1200
32	1200	600
64	600	300
128	300	150

<Note>

The clock input frequency to CTC is the next.
(1) **x 1**   -- 153.6 KHz
(2) x 16 -- 1.2288 MHz

<u>Table 20 **:** CTC **Setting** List</u>

Z80A CTC has 4 channels, from which 2 channels of those are allocated for forming the Baud-Rate clock for the Serial I/O. Channel 1 is used for forming the Baud-Rate clock of 'Channel-A' of **the** Serial I/O, and Channel 2 is used for forming the Baud-Rate clock of 'Channel-B' of **the** Serial **I/O.** Z80A SIO has **'W/RDYA'** and **'W/RDYB'** pins, which **are connected** with 'RDY' (DMA request) pin of Z80A DMA of the Formula-l. Therefore it is possible to transfer DMA by setting the parameters in the Z80A SIO as well.

[12]-1-2 Parallel I/O (Z80A PIO)

In order to know detail information about hardware format of the Parallel I/O of Formula-l, please refer to item No. < [6]-3 Centronics Standard Printer Interface >. According to our company standard Parallel I/O has been set on to use with Centronics Standard Interface Printer. When you intend to use for other purposes, it is necessary to **change jumper at first, and** then initialize the **parameter.**

Note 1 : Due to our company standard, IC of Parallel I/O has **already** soldered with Main PCB. However, if you intend to use such for general purposes, you should **detach the IC soldering and attach IC sockets.**

Note 2 : Further, time to **time you** have to **change IC's, IC positions, jumpers, as well as pull-up** resistors either attach or detach according to your specific use.

[12]-1-3 Counter & Timer (Z80A CTC)

As we have stated in the item **No.** < [12]-1-1 Serial I/O (Z80A SIO) > the user can only use two channels #0 and #3 together **or separately.**
For detail please refer to < Fig. 5 : Logic of Counter & Timer >.

Channel #0   8, bits programmable timer

Channel # 1   Baud-Rate setting of Serial I/O Channel-A

Channel #2   Baud-Rate setting of Serial I/O Channel-B

Channel #3   8 bits programmable Counter/Timer

Timer clock's channel #0 and #3 are of 4 MHz connected to system clock. You can input separately either the 'Zero Count' signal of channel #0 or 'External Clock' signal coming from outside system into counter clock of channel #3 by selecting the short-plug/jumper accordingly.

In standard, do not **change** parameters of channel #1 and #2 at all. However, if you intend to change the Baud-Rates, only then you should change the parameters of channel #1 and #2.

[12]-1-4 Direct Memory Access (Z80A DMA)

The DMA of this computer being used for the purpose of transferring data in between memory and floppy diskettes. You can also use **DMA** for data transferring in some other purpose as well. Although in this one should be very careful, because if you call 'FDC Subroutine Program' the parameter of DMA will certainly get damage.
Apart from transferring data from floppy disk drives, it can also transfer data from the following:-

Serial I/O.(Channel-A, Channel-B)

Memory to Memory Transfer

External (DMAREQ) Terminal

This DMA has a higher functions, very complex in use, therefore, one should use it after thoroughly understanding the manuals.

[12]-1-5 Interrupt

The interrupt's order of priority is below mentioned. Further, there has been specific order of priorities in each chips itself. Therefore, in order to get detail information pertaining to the chips, you must refer to 'The Specifications of Z80A Family Chips'.

High   1, Counter & Timer   (Z80A CTC)

         2, Serial I/O   (Z80A SIO)

         3. Parallel I/O   (Z80A PIO)
I
Low   4. DMA   (Z80A DMA)

As our standard, with the Formula-l we do not utilize interruption at all. Therefore, if you are interested, you should make your own interrupt program according to your specific **use.**

Note : 'The Specifications of Z80A Family Chips', are available with 'Zilog Inc.,' USA.

[12]-2 I/O Map

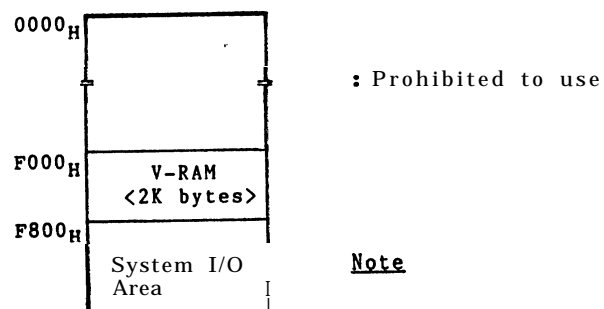The following shows the I/O address structure of the Formula-l.

: Prohibited to use

Note

Fig. 24 : I/O Address Structure

Note   System I/O Area.
Detail information being provided in < Table 21 : User's Device I/O Map **(1),(2),(3)** and (4) >.

Device Name	I/O Adrs.	Input								Remarks
		D7	D6	D5	D4	D3	D2	D1	D0	
DMA (Z80A DMA)	F800H	STS7	STS6	STS5	STS4	STS3	STS2	STS1	STSC	DMA Status
Baud-Rate Switch	F808	CHB SW3	CHB SW2	CHB SW1		CHA SW3	CHA SW2	CHA SW1		SIO (CHA, CHB) Baud-Rate Set
Counter & Timer (Z80A CTC)	F820	TM07	TM06	TM05	TM04	TM03	TM02	TM01	TM00	Channel 0, Data
	F821	TM17	TM16	TM15	TM14	TM13	TM12	TM11	TM10	Channel 1, Data
	F822	TM27	TM26	TM25	TM24	TM23	TM22	TM21	TM20	Channel 2, Data
	F823	TM37	TM36	TM35	TM34	TM33	TM32	TM31	TM30	Channel 3, Data
Thermal Printer (Z80A PIO)	F824	PD7	PD6	PD5	PD4	PD3	PD2	PD1	PD0	Print Out Data
	F825									Invalid
	F826	KBST	PULS	BUSY	C/G	STA	CA2	CA1	CA0	K/B & Printer Status
	F827									Invalid
Parallel I/O (Z80A PIO)	F828	PD7	PD6	PD5	PD4	PD3	PD2	PD1	PD0	Print Out Data
	F829									Invalid
	F82A	ACK	BUSY	PEMP	SEL			INIT	STB	Printer Status
	F82B									Invalid
Floppy Disk Controller (MB8876)	F828	STS7	STS6	STS5	STS4	STS3	STS2	STS1	STS0	FDC Status
	F829	TRK7	TRK6	TRK5	TRK4	TRK3	TRK2	TRK1	TRK0	Track Register
	F82A	SEC7	SEC6	SEC5	SEC4	SEC3	SEC2	SEC1	SEC0	Sector Register
	F82B	DAT7	DAT6	DAT5	DAT4	DAT3	DAT2	DAT1	DAT0	Data Register
Serial I/O (Z80A SIO)	F830	SIA7	SIA6	SIA5	SIA4	SIA3	SIA2	SIA1	SIA0	CH-A, Rx Data
	F831	STS7	STS6	STS5	STS4	STS3	STS2	STS1	STS0	CH-A, Status
	F832	SIB7	SIB6	SIB5	SIB4	SIB3	SIB2	SIB1	SIB0	CH-B, Rx Data
	F833	STS7	STS6	STSS	STS4	STS3	STS2	STS1	STS0	CH-B, Status

Table 21 : User's Device I/O Map (1)

Left table

Device Name	I/O Adrs.	Input D7	D6	D5	D4	D3	D2	D1	D0	Remarks
EP-ROM Programmer (Z80A PIO)	F834	RDT7	RDT6	RDT5	RDT4	RDT3	RDT2	RDT1	RDT0	EP-ROM Data
	F835									Invalid
	F836	TIME	2532	2716	C̄S̄	P̄R̄ḠM̄	WRT	POW	ADRS	EP-ROM Status
	F837									Invalid
Keyboard	F838	KB7	KB6	KB5	KB4	KB3	KB2	KB1	KB0	Keyboard Data
Floppy Disk I/O (Z80A PIO)	F83C	TK60	BUZ	2̄S̄ĪD̄	M̄ŌT̄R̄	D̄R̄D̄Ȳ	C̄H̄N̄Ḡ	D̄R̄Q̄	Ī R̄Q̄	Floppy Status
	F83D									Invalid
	F83E	DBL	8"	MOTR	SIDE	DRV3	DRV2	DRV1	DRV0	Drive Register
	F83F									Invalid

Table 21 : User's Device I/O Map (2)

Right table

Device Name	I/O Adrs.	Output D7	D6	D5	D4	D3	D2	D1	D0	Remarks
DMA (Z80A DMA)	F800H	CMD7	CMD6	CMD5	CMD4/D4	D3	CMD2	CMD1	CMD0	DMA Command
CRT (HD46505S)	F804					REG3	REG2	REG1	REG0	CRTC Register Select
	F805	CRT7	CRT6	CRT5	CRT4	CRT3	CRT2	CRT1	CRT0	CRTC Command
Interrupt	F814	Interrupt Flag Reset								Ignore Data Bit
System	F81C	Boot-Strap ROM Disable								Ignore Data Bit
Counter & Timer (Z80ACTC)	F820	CMD7	CMD6	CMD5	CMD4	CMD3	CMD2	CMD1	CMD0	Channel 0 Command (User)
		TM07	TM06	TM05	TM04	TM03	TM02	TM01	TM00	
	F821	CMD7	CMD6	CMD5	CMD4	CMD3	CMD2	CMD1	CMD0	SIO (CH-A) Baud-Rate Clock
		TM17	TM16	TM15	TM14	TM13	TM12	TM11	TM10	
	F822	CMD7	CMD6	CMD5	CMD4	CMD3	CMD2	CMD1	CMD0	SIO (CH-B) Baud-Rate Clock
		CM27	CM26	CM25	CM24	CM23	CM22	CM21	CM20	
	F823	CMD7	CMD6	CMD5	CMD4	CMD3	CMD2	CMD1	CMD0	Channel 3 Command (User)
		CM37	TM36	TM35	TM34	TM33	TM32	TM31	TM30	
Thermal Printer (Z80A PIO)	F824	PD7	PD6	PD5	PD4	PD3	PD2	PD1	PD0	Print Out Data
	F825	CMD7	CMD6	CMD5	CMD4	CMD3	CMD2	CMD1	CMD0	Port-A, Command
	F826				C̄/G	S̄T̄Ā	CA2	CA1	CA0	Printer Command
	F827	CMD7	CMD6	CMD5	CMD4	CMD3	CMD2	CMD1	CMD0	Port-B, Command
Parallel I/O (Z80A PIO)	F828	P̄D̄7	P̄D̄6	P̄D̄5	P̄D̄4	P̄D̄3	P̄D̄2	P̄D̄1	P̄D̄0	Print Out Data
	F829	CMD7	CMD6	CMD5	CMD4	CMD3	CMD2	CMD1	CMD0	Port-A, Command
	F82A							ĪN̄ĪT̄	S̄T̄B̄	Printer Command
	F82B	CMD7	CMD6	CMD5	CMD4	CMD3	CMD2	CMD1	CMD0	Port-B, Command

Table 21 : User's Device I/O Map (3)

Device Name	I/O Adrs.	Output								Remarks
		D7	D6	D5	D4	D3	D2	D1	D0	
Floppy Disk Controller (MB8876)	F828	CMD7	CMD6	CMD5	CMD4	CMD3	CMD2	CMD1	CMD0	FDC Command
	F829	TRK7	TRK6	TRK5	TRK4	TRK3	TRK2	TRK1	TRK0	Track Register
	F82A	SEC7	SEC6	SEC5	SEC4	SEC3	SEC2	SEC1	SEC0	Sector Register
	F82B	DAT7	DAT6	DATS	DAT4	DAT3	DAT2	DAT1	DAT0	Data Register
Serial I/O (Z80A SIO)	F830	SOA7	SOA6	SOA5	SOA4	SOA3	SOA2	SOA1	SOA0	CH-A, Tx Data
	F831	CMD7	CMD6	CMD5	CMD4	CMD3	CMD2	CMD1	CMD0	CH-A, Command
	F832	SOB7	SOB6	SOB5	SOB4	SOB3	SOB2	SOB1	SOB0	CH-B, Tx Data
	F833	CMD7	CMD6	CMD5	CMD4	CMD3	CMD2	CMD1	CMD0	CH-B, Command
EP-ROM Programmer (Z80A PIO)	F834	RDT7	RDT6	RDT5	RDT4	RDT3	RDT2	RDT1	RDT0	EP-ROM Data
	F835	CMD7	CMD6	CMD5	CMD4	CMD3	CMD2	CMD1	CMD0	Port-A, Command
	F836	X	2532	2716	CS	PRGM	WRT	POW	ADRS	EP-ROM Command
	F837	CMD7	CMD6	CMD5	CMD4	CMD3	CMD2	CMD1	CMD0	Port-B, Command
Floppy Disk I/O (Z80A PIO)	F83C	TK60	BUZ							Buzzer & etc.
	F83D	CMD7	CMD6	CMD5	CMD4	CMD3	CMD2	CMD1	CMD0	Port-A, Command
	F83E	DBL	8"	MOTR	SIDE	DRV3	DRV2	DRV1	DRV0	Drive Register
	F83F	CMD7	CMD6	CMD5	CMD4	CMD3	CMD2	CMD1	CMD0	Port-B, Command

Table 21 : User's Device I/O Map (4)

Table 22: CRT & Printer Character Code Table (1)   * Direct set

Table 22 : CRT & Printer Character Code Table(2)

* Subroutine call

All mode		S I						S O						Graphic					
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	1	1	1	1	0	0	1	1	1	1	0	0	1	1	1	1
0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
0	1	2	3	4	5	6	7	2	3	4	5	6	7	2	3	4	5	6	7
		SP	0	@	P	`	p					♠	↑			—	⌐	♠	↑
		!	1	A	Q	a	q					♥	↓	■	▨	⊥	⌐	♥	↓
		"	2	B	R	b	r					♣	→	■	▦	⊤	⌐	♣	→
	DC3	#	3	C	S	c	s					♦	←	■	▨	—	◣	♦	←
	DC4	$	4	D	T	d	t					○	π	■	▨	│	◤	○	π
		%	5	E	U	e	u					●	μ	■	▨	├	◤	●	μ
		&	6	F	V	f	v					—	Ω	■	▨	┤	▶	—	Ω
BELL		'	7	G	W	g	w				│	/	∅	■	▨	│	◢	│	∅
BS		(	8	H	X	h	x					☺	■	▨	┘	∨	☺
HT		)	9	I	Y	i	y					●	■	▨	└	<	●
LF		*	:	J	Z	j	z					大	■	▨	┐	∧	大
	ESC	+	;	K	[	k	{					⚔	■	▨	┌	>	⚔
		,	<	L	\	l	¦					┻	■	▨	┼	┘	┻
CR		-	=	M	]	m	}					┛	■	▨	\	└	┛
SO		.	>	N	^	n	~					木	■	▨	/	│	木
SI		/	?	O	_	o						木	■	▨	×	└	木

Table 23 : Video-RAM I/O Map (Initial State)

1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80

[13] Bundled Software Packages

Following Bundling Software Packages available with our system unit.

1) WordStar (including **MailMerge** and **SpellStar)**

2) CalcStar

3) InfoStar System (including **DataStar, ReportStar** and **FormSort)**

1. WordStar

The Formula-l with *WordStar' **(MailMerge and SpellStar)** can process letters, customers lists, **contracts,** manuals and immense of 'OA' work with speed and proficiency. WordStar is a complete wordprocessing system that makes it easy for you to **type** any kind of letter or document. WordStar offers all **the features of** the most advanced electric typewriter, plus many more features not found in other typewriter.

2. CalcStar

The Formula-l **with** 'CalcStar' is a high-productive business tool designed to save your time and money. Thereby advanced statistical analysis, business forecasting, account payable, depreciation schedules, payroll **all** made easy and accurate. CalcStar is MicroPro's powerful electronic spread **sheet —** a sophisticated, yet easy to use calculating and business planning **tool** specially for quality work.

3. InfoStar System

'InfoStar System' **with** the Formula-l, most users friendly and efficient companion for Data Base Management. InfoStar System is **the** latest **addition to** the MicroPro line of software. **It's** much more than just **an** addition though, quite an enhancer to your library or software. **InfoStar System is** easy to learn for the beginner, yet **carries the power that professionals need.**

(131-l   Installation of Bundled Software Packages

1. WordStar

According to our company standard, we have already installed 'WordStar' in order **to use immediately along with** system 'Formula-l' and 'Formula FP-80' printer.

If you intend to use some other maker's printers, please refer to 'WordStar Installation Manual' along with your printer's specification manual for detail.

2. CalcStar

When using 'CalcStar', you do not require installation at all.

You can use any standard printer **which has already been assigned to 'LST:'** the **output list device.   For detail, please** refer to 'Formula-l User's Manual' **section < [11]-3 Device allocation >.**

3. InfoStar System

When using **'InfoStar System'** you do not require installation **at** all.

You can use any standard printer **which has already been** assigned to LST**:** the output list device.   For detail, please refer to 'Formula-l User's Manual' section < **[11]-3** Device allocation **>.**

<u>**Note :**</u> **You can use only system's '5.5' CRT' or 'FM-9' with** this Formula-l system.

Since above CRTs already being **installed   according to** bundling software packages, therefore you do not require to install **it** again.

[13]-2   Function-Keys Assignment for WordStar

We have **assigned** all Function-Keys specially in order to make easy to use 'WordStar' application program without using original keys commands.

Therefore you should follow below mentioned table to use the assigned Function-Keys and commands.

^Q	^O	^OC	^OD	^OG	.OP	.PA	^KD	^KS	^QE	^D	^S	^E	^X
F1	F2	F3	F4	F5	F6	F7	F8	F9	HOME	→	←	↑	↓

```
 F1 : <CTRL> ' Q '      : Quick menu
 F2 : <CTRL> ' 0 '      : On screen menu
 F3 : <CTRL> 'O C'      : Center text
 F4 : <CTRL> 'O D'      : Print display on/off
 F5 : <CTRL> 'O G'      : Paragraph tab
 F6 : .OP <RETURN>      : Omit page number
 F7 : .PA <RETURN>      : Change page
 F8 : <CTRL> 'K D'      : Files save -- done
 F9 : <CTRL> 'K S'      : Files save & resume

HOME: <CTRL> 'Q E'      : Moves the cursor to top line
  → : <CTRL> ' D '      : Moves the cursor right one character
  ← : <CTRL> 'S'        : Moves the cursor left one character
  ↑ : <CTRL> ' E'       : Moves the cursor up one line
  ↓ : <CTRL> ' X '      : Moves the cursor down one line
```

[13]-3   Option Commands for WordStar & InfoStar SYSTEM

1.   Bold face (FP-80 function)

^A : Bold face on
^N : Bold face off

2.   Under score (FP-80 function)

^Y : Under score on/off (toggle)

3.   Italic

^E : Italic on
^Q^R : Italic off

4.   Character pitch

^W : 5 cpi
^Q^W : 8 cpi (bold face)
^R : 10 cpi
^Q : 17 cpi (bold face)

[13]-4 Procedure of File Copy

```
 *** 60K CP/M Vera. 2.2 Formula-l System ***
 BIOS Created By YCU Co., Ltd. (1983.**.**)
 A>B:
 B> C
 B>A:
 A>PIP B:=A:PIP.COM[VO]

 A>PIP B:=A:STAT.COM[VO]

 A> C
 A>PIP A:=B:*.*[VO]
```

Fig. 25 : Method of Copying

PROCEDURE OF COPYING A NEW DISKETTE FROM ORIGINAL DISKETTE

1. Insert the **'CP/M-80** SYSTEM DISKETTE' into Drive 'A'
    and lock.

2. Insert a new diskette into Drive **'B'.**
    (which has already 'FORMAT and SYSTEM').

3. Type 'B:' and press <RETURN>.

4. Press **<CTRL>** 'C'.
    (Holding the **<CTRL>** key down while you type **'C'.)**

5. Type 'A:' and press <RETURN>.

6. Type 'PIP **B:=A:PIP.COM[VO]'** and press <RETURN>.
    Type 'PIP **B:=A:STAT.COM[VO]'** and press <RETURN>.

7. Take out the **'CP/M-80** SYSTEM DISKETTE' from Drive 'A'.
    Take out inserted new diskette from Drive 'B' and insert
    it into Drive 'A'.

8. Now, insert into Drive 'B' the 'Original Diskette'
    from which you want to copy.

9. Press **<CTRL>** 'C'.
    (Holding the **<CTRL>** key down while you type 'C'.)

10. Type 'PIP **A:=B:*.*[VO]** and press <RETURN>.

11. Wait till Copying Process END.

Note   When you intend to copy specific files, please refer
        to our **"CP/M-80** OPERATING SYSTEM MANUAL's PIP COMMAND"
        for detail,

[13]-5 Procedure of Assigning External Printer

Generally, as per our company standard at the state of
power switch 'ON' the system's thermal printer being already
assigned to operate. Therefore, you do not require to assign
'STAT' command. However, when you intend to use an external
printer with Centronics Standard Interface, you should type
following command at first.

When you **get** prompt 'A>' on your CRT at the beginning
type following command.

A>STAT LST:=LPT: <RETURN>

A>

Note   Please refer to our **"CP/M-80** OPERATING SYSTEM MANUAL's
        STAT COMMAND" for detail.

[14] Application Software Packages

The Formula-l is a superb device for data processing at the office, store, laboratory, etc. and software development tool for process-control system, mechatronics (mechanism/electronics) system and medical electronics system, etc.

Therefore, various kinds of application software packages available on the market, operating on the CP/M-80 works well with the Formula-l. For example Data Base Management Systems, Financial Accounting Packages, Languages & Applications Tools, Numerical Problem-Solving Tools, ,etc. Details are specified in the software manuals.

* Summary

1. System Tools 1 (Assembler, Debugger, Linker, etc.)

   DISILOC
   DISTEL
   MAC
   MACRO-80
   PLINK-II
   RAID
   SID
   280 Development Package
   280 Development Package + ZDT
   280 TDL Package (EDIT t PASM t PLINK t BUG/uBUG)
   ZDT
   ZMAC (Z80M/S)
   ZSID

2. System Tools 2 (Editors)

   EDIT-80
   MINCE
   PMATE
   WORDMASTER

3. System Tools 3 (System Utilities)

   DESPOOL
   FILETRAN
   IBM/CPM
   ISIS/CPM (CID/S)
   RT11/CPM (CRX/S)
   RECLAIM
   ZAP-80

4. Cross Assemblers/Compilers

   XASM-OS
   XASM-09
   XASM-18
   XASM-48
   XASM-51
   XASM-65
   XASM-68
   XASM-F8
   XASM-Z8
   XS-8000

5. Languages

   ALGOL-60
   APL/V80
   BASIC-80 (Interpreter)
   BASIC COMPILER
   baZic I I
   BDS C Compiler
   CBASIC-2
   CIS COBOL (Standard)
   COBOL-80
   FORTRAN-80
   JRT PASCAL
   KBASIC
   muLISP
   NEVADA COBOL
   PASCAL/M
   PASCAL MT t with Speed Programming Package
   PASCAL/Z
   PL/1-80
   Rgy FORTH F80
   Rgy FORTH FZ80
   SBASIC
   STIFF UPPER LISP
   Timin FORTH
   tiny C
   tiny C II
   WHITESMITH'S C COMPILER
   ZIL Compiler
   ZIL Interpreter

6. Language & Applications Tools

BASIC UTILITY DISK (for BASIC-80)
FABS I
FABS II
FORMS 2 (for CIS COBOL)
MAG/sam3 (for CBASIC-2 OR BASIC-80)
MAG/sam4 (for CBASIC-2)
MAG/sort
M/SORT (for COBOL-80)
PSORT
STRING/80 (for Microsoft languages)
STRING/80 source code
STRING BIT (FORTRAN source)
SUPERSORT
ULTRASORT II
VISAM (for PL/1-80)

7. Telecommunications

ASCOM
BSTAM
BSTMS
BTAM-80
CICS-80
RBET-80
RJE-80

8. Word Processing Systems and Aids

BENCHMARK
MAGIC WAND
MICROSPELL
SPELLGUARD
TEXTWRITER III
DOCUMATE/PLUS
WORDINDEX
WORDSTAR CUSTOMIZATION NOTES

9. Data Management Systems

CONDOR S-20
dBASE II
MAG/base1
MAG/base2
MAG/ base3
Micro-SEED
TIM-III
CBS
SELECTOR III-C2
SELECTOR IV

10. Business Packages

ACCOUNT PAYABLE(P.T.)
ACCOUNT RECEIVABLE (P.T.)
ANGEL
APARTMENT MANAGEMENT
BOSS FINANCIAL ACCOUNT SYSTEM
DATEBOOK-I I
DENTAL MANAGEMENT SYSTEM 8000
DENTAL MANAGEMENT SYSTEM 9000
GENERAL LEDGER (P.T.)
GLECTOR
GRAFTALK
GUARDIAN
INSURANCE AGENCY SYSTEM 9000
INVENTORY (P.T.)
MAILING ADDRESS
MEDICAL MANAGEMENT SYSTEM 8000
MEDICAL MANAGEMENT SYSTEM 9000
PAS-3 DENTAL
PAS-3 MEDICAL
PAYROLL (P.T.)
POSTMASTER
PROPERTY MANAGEMENT (P.T.)
SALES PRO
WIREMASTER

11. Numerical Problem-Solving Tools

T/MAKER II
FPL
MICROSTAT
muSIMP/muMATH
PLAN80
STATPAK

Note : Program name, system name, CPU name, etc., are their own
registered trademarks of the each company.

[15] Operation .

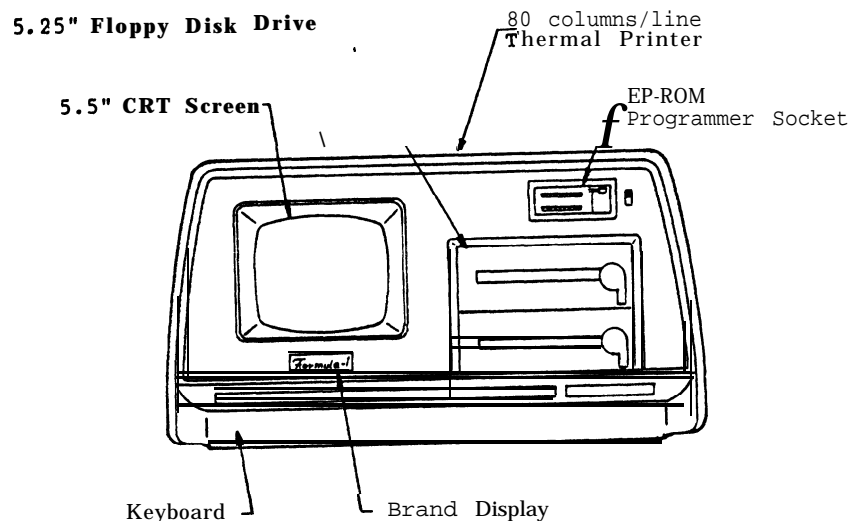The following shows the front **and rear** view **of the Formula-l.**

5.25" Floppy Disk Drive

80 columns/line
Thermal Printer

5.5" CRT Screen

EP-ROM
Programmer Socket

Keyboard

Brand Display

Fig. 26 : Front View of the Formula-l

Fan,

RS-232-C(CH-B)
Connector

RS-232-C(CH-A)
Connector

Parallel I/O
Connector

AC Connector

8" Floppy Disk
Drive Connector

Jumper,Baud-Rate

Fuse

BNC Connector

Power Switch

5.25" Floppy Disk
Drive Connector
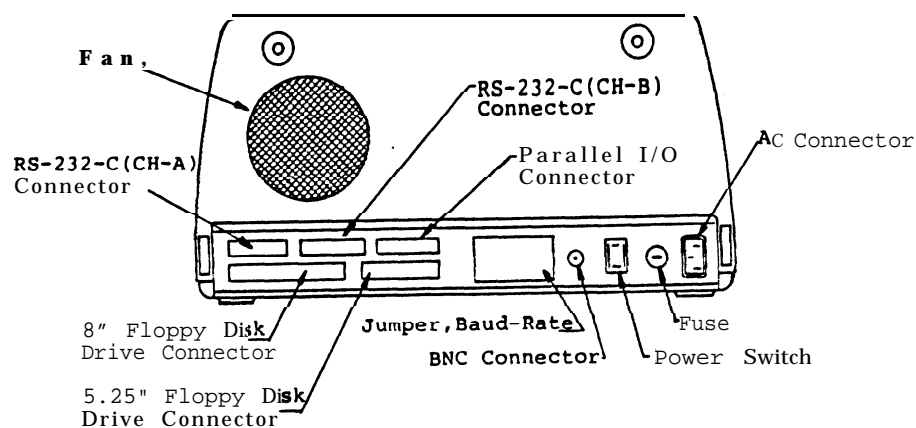
Fig. 27 : Rear View of the Formula-l

[15]-1   Power-ON Setting

First, connect AC-cable with AC-connector **on** the **rear** side **and** put the plug of the **cable** into **an** outlet of AC-power. **Next, turn ON the power switch, which is on the rear side of the** Formula-l.   Pull out the diskette from the floppy disk drives, **before you turn ON** or **OFF the power switch.**

If AC-power is supplied correctly, the brand name of the Formula-l being displayed immediately.   Thereafter, the following **message** will appear on your CRT.

Formula-l   IPL Vers ***.* for mini 2D**

In this state, insert the System Diskette into the Drive 'A' correctly.

Indicator
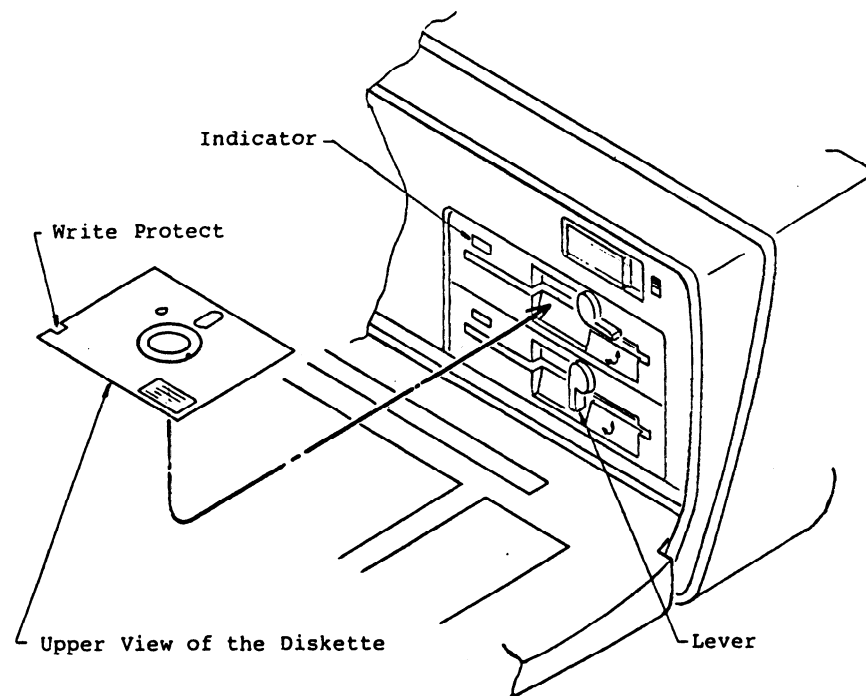
Write Protect

Upper View of the Diskette

Lever

Fig. 28 : Direction of the Diskette Insertion

Lock the disk drive after inserting the diskette, following **message** will appear on your CRT, and the system starts.

    *** 60k **CP/M** Vers. 2.2 Formula-l system *******
    BIOS created By YCU **Co.,** Ltd. **(1983.**.**)**

    A> ⊤_____   Cursor

Up to this operation, if the below error message appear, this means insertion of the diskette is not correct. So, reset the diskette again. If you still get an error, then you should assume that there is something wrong with the diskette.

    IPL error **!**   (Error message)

    or

    BOOT err.

Check the following points, when power is not supplied even after you turn ON the power switch.

1. Check: AC-cable connectors inserted properly into the system unit as well **as** AC-outlet.

2. Check: If exact AC-power voltage from the AC-outlet being supplied to the system unit.

3. Check: If the fuse has blown?

Do not repeat ON/OFF operation of the power switch, otherwise there is **a** possibility of an error.

Turn ON the power switch at least after 2 or 3 seconds passed, if the power switch being turned OFF previously.

[15]-2 System Reset

In order to reset the Formula-l without using the power switch, you should hold the **<CTRL>** key down while you press <RESET> key and release one of the two keys, thereafter you will find system being reset.
This state is similar to the state, when you turn ON the power switch.

[15]-3 EP-ROM Programmer Socket

At first, you should make sure the number of pins on the EP-ROM and thereafter insert EP-ROM into the socket, by matching extreme left pin and pin hole together. Be careful not to make any mistake, otherwise you will spoil the EP-ROM. You **must .make** sure that head of the EP-ROM is on the right hand side as we have shown in the bellow figure. Then move the socket lever to the right side in order to lock the EP-ROM.

You must follow below figures for inserting EP-ROM accurately.

Slide switch UP or DOWN, according to EP-ROM as mentioned here under:-

2716 **/** 2516, 2732 and 2532 ▬▬▬▬▬▬▬ switch UP
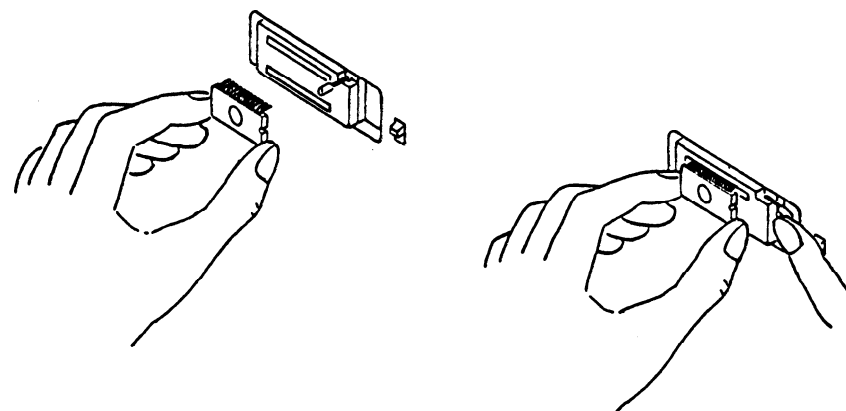2764 ---------------------------------- switch DOWN

Fig. 29 **:** Disposition of EP-ROM Socket Pin

[15]-4 Procedure of Changing Roll Paper

The system printer of the Formula-l is a thermal printer.
Therefore, you need thermal paper to feed this printer.
In case of storing thermal roll paper, you should pay attention
on the following points:-

1. Do not inflict an intense heat on a roll paper.

2. Avoid the direct sun for a long time.

3. Do not put any material, chemicals, etc., on the roll
    paper otherwise the color of the paper might change
    due to reaction.

Use the paper designated by our company.

127(W) x 65(Dia.) mm roll paper
No. TP-50CA127 (Jujo Seishi)

First, open the printer cover of the Formula-l, and move
left side lever towards '0' as directed on the system unit.
Now, roll paper is free and therefore pull out old roll paper.
Next, set a new paper, and push slowly the front edge of the
roll paper in the lower part of the pinch roller.
By pushing side edges of the roll paper in, front edge of
the paper will come out from paper outlet, which is right
behind the paper cutter.

Now, adjust the paper properly and push the lever towards
'C' as directed on the system unit in order to lock.
So, the roll paper is fixed, setting is over.
Then, push <FEED> key and confirm whether the roll paper being
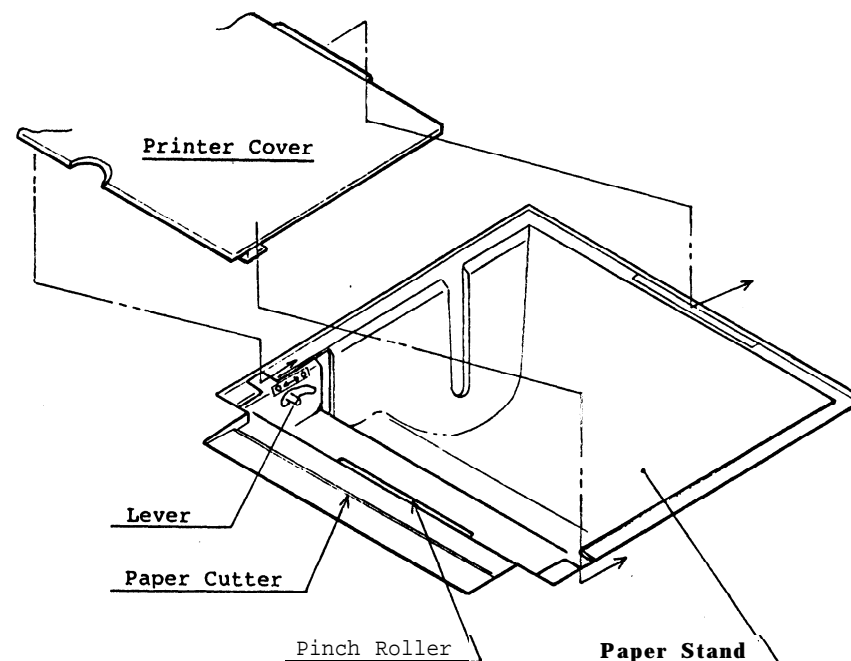fed properly.
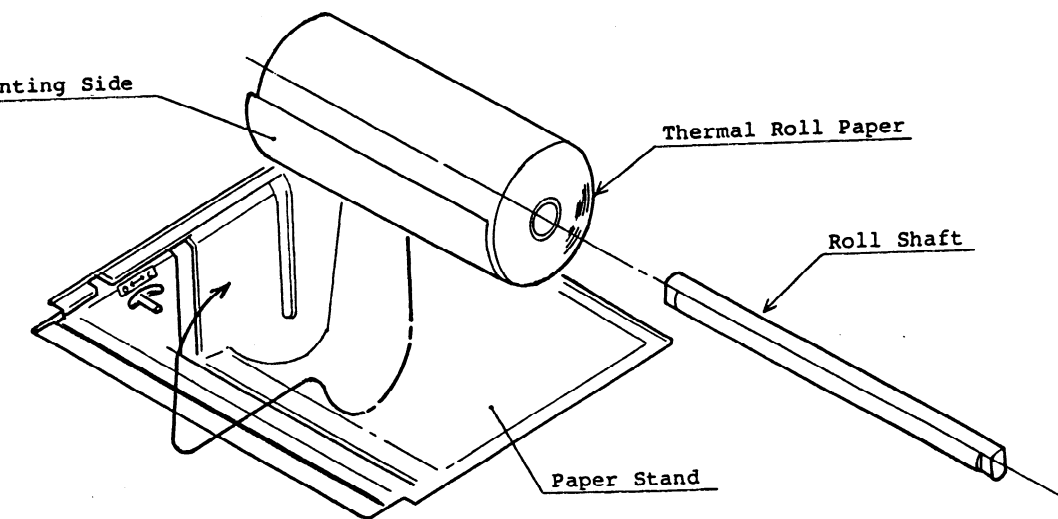

Fig. 30 : Upper View of Paper Stand

nting Side

Thermal Roll Paper

Roll Shaft

Paper Stand

Fig. 31: Roll Paper Handling