PX-8
OS Reference Manual

Trademark Acknowledgments

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CONTENTS

Chapter 1 Introduction

1.1 Purpose of This Manual

This manual describes the functions of the operating system for the EPSON PX-8, HC-80, and HC-88 series (referred to as MAPLE) microcomputer systems. It is intended for system house users who are to develop applications programs which make the best of the MAPLE's capabilities.

The reader is assumed to be familiar with the following:

- Basic knowledge about the CP/M operating system
- General knowledge about machine-language programming
- Z80 instructions

1.2 Before Reading This Manual

This manual uses the following notational conventions:

(1) Data representation

This manual discusses binary, decimal, and hexadecimal numbers. They are represented in the formats:

Binary:	00100011B (Numbers are followed by 'B')
Decimal:	35 (only numerals)
Hexadecimal:	23H (Numbers are followed by 'H')

Character constants are enclosed in apostrophes (').

Example:

'ABC'

(2) Operating system types

The MAPLE runs in three types of operating systems (OS).

In this manual, these operating systems are

distinguished as follows:

ASCII (OS): ASCII ver. OS (PX-8)

JIS (OS): Japanese-language JIS Keyboard OS (HC-80, -88)

TXT*(OS): Japanese-language TXT Keyboard OS (HC-80, -88T)

* TXT stands for the Touch-16 Japanese language input methods originally developped by EPSON.

Japanese-language (OS): Japanese-language JIS and TXT Keyboard OSs

Chapter 2 General Description and System Configuration

2.1 MAPLE System Configuration

The MAPLE is a successor of the worldly-accepted EPSON HC-20 hand-held computer. It is a new generation hand-held computer which incorporates in its compact body much more functions than ordinary desktop microcomputers. With its battery-driven power supply, the user can user the MAPLE any time, any place, even outside the office.

To further augment this outstanding portability feature, EPSON supplies a wide variety of peripheral devices and options. For example, the MAPLE employs a large (80 columns by 8 lines) LCD screen. With the virtual screen support, the MAPLE allows the user to create display images larger than those the conventional CRT devices can provide. The MAPLE is furnished as standard microcassette drives which are completely controlled by the distribution operating system so the user can handle them as easy as floppy disk units. Another standard device is an RS-232C interface which enables the MAPLE to communicate with other computers directly or via a telephone lines. When combined with an optional microfloppy disk drives, P-80 printer, or CP-20 acoustic coupler, all are battery driven!, the MAPLE provides a full computing environment even in locations where no commercial AC source. The main unit proper will meet most of daily business needs.

The MAPLE employs as its operating system the industry standard CP/M version 2.2 operating system implemented in ROM. This allows the user to implement an abundance of commercial CP/M application programs on the MAPLE. In addition to the supports for all MAPLE peripheral devices, the MAPLE CP/M has many extended functions which will help the user develop application programs for the MAPLE.

The MAPLE with the Japanese-language OS and Japanese-language processor unit supports kanji processing so that the user can easily construct application programs using kanji characters.

The ideal combination of the MAPLE with the software that make the best of the MAPLE's portability and capability will explore new computer uses that no one ever imagine.

2.2 Hardware Configuration

2.2.1 Hardware Configuration (see block diagram)

(1) CPU

The MAPLE uses three processors: Z80, 6301, and 7508. The 6301 and 7508 processors are used mainly to control I/O operations to reduce the burden of the Z80 central processing unit.

1) Z80

- Main CPU
- CMOS version
- 2.46 MHz clock

2) 63Ø1

- 8-bit CPU
- CMOS version
- 614 KHz clock
- Contains 4K-byte program

The 63Ø1 CPU controls the following I/O devices:

- Screen (LCD)
- Serial Interface
- Microcassette
- ROM capsule
- Speaker

3) 75Ø8

- 4-bit CPU
- CMOS version
- 200 KHz clock
- Contains 4k-byte program

The 75Ø8 CPU controls the following I/O devices

- Keyboard
- Power supply to main CPU
- RESET SW
- Battery voltage port

- Temperature data port
- Calendar ports
- Alarm port
- 1-second software timers

(2) Memory

OS ROM:	32K bytes (CMOS mask ROM)
Main ROM:	64K bytes (CMOS DRAM)
VRAM:	6K bytes (CMOS DRAM)

- The OS ROM and main RAM are bank-switched.
- VRAM is controlled by the 6301 processor.
- The main RAM and VRAM are battery backed up and their data are sustained even when power switch is turned off.

(3) Battery

Two types of rechargeable Ni-Cd batteries are used:

Main battery capacity:	1100 mAH
Subbattery capacity:	90 mAH

Normally, the main battery is held on. When the power voltage falls down to 4.7 volts, power is switched from the main battery to subbattery and the subbattery maintain only power to the RAM. Recharging (tricle recharging) is accomplished using the attached AC adapter. Eight hours after tricle recharging is started with the AC adapter, recharging is stopped to prevent overcharging from damaging the battery. The main battery charges the subbattery while it is in operation.

(4) Interrupt handling

Z80 mode 2 interrupts are used for interrupt to Z80. Six interrupt levels are available. They are listed below in the descending order of priority:

1) Interrupts from the 7508
2) RS-232C receive interrupt from 8251
3) CD (Carrier Detect) interrupt from RS-232C interface
4) FRC (Free Running Converter) overflow interrupt
5) ICF (Interrupt Catch Flag) interrupt from the bar code reader.
6) External interrupt

2.2.2 Built-in I/O devices

(1) Keyboard

- The keyboard consists of 66 keys and six switches (66 keys and seven switches for Japanese-language version).
- The keyboard supports N-key rollover feature.
- The keyboard also supports auto repeat feature.

(2) LCD

- 480 dots (wide) x 64 dots (long)
  Dot size: 0.41 mm (wide) x 0.45 mm (long)
  Dot spacing: 0.46 mm (wide) x 0.50 mm (long)
- 80 characters by 8 lines (30 characters by 3 lines for kanji characters)
- The LCD panel swivels in the range of 180° in 13 intervals.
- The LCD view angle can be controlled by a slide switch.
- 1/64 duty

(3) Microcassette drive

- The microcassette drive is controlled by software.
- Allows Dame recording and playback. Only playback is possible with voice information.
- The sound from the microcassette drive can be monitored using the internal or external speaker.
- The tape speed is 2.4 cm/second.

(4) ROM capsule

- 28-pin 2764/27128, 27256, or equivalent.
- NMOS or CMOS mask ROM or PROM is possible.
- A ROM capsule can contain up to two ROM chips. They may be used single or in combination.
- Power to the ROM is supplied only when it is accessed, which is controlled by software.
- The ROM capsule allows easy installation or removal by the user.

(5) Built-in dynamic speaker

- Compact dynamic speaker
- The frequency and duration can be controlled by software.
- The volume can be adjusted with a volume control.
- The output can be connected to an external speaker interface.

2.2.3 External Interfaces

(1) RS-232C

- The RS-232C interface uses a CMOS 8251 controller chip (compatible with Intel 8251A).
- The output level is ± 8 volts.
- The power to the driver is controlled by software.
- 8-pin mini-DIN connector is used.
- Bit rates (bps)

  TX: 110, 150, 200, 300, 600, 1200

  RX: 110, 150, 200, 300, 600, 1200

  TX: 240, 4800, 8600, 19200

  RX: 240, 4800, 8600, 19200

  TX: 1200, 75

  RX: 75, 1200

- Number of start bits: 1
- Number of stop bits: 1, 2
- Data length: 7, 8
- Parity: Even, odd, none
- Full duplex/half duplex

(2) Serial interface

- The output level is $\pm$ 8 volts.
- The power to the driver is controlled by software.
- The driver is shared with the RS-232C interface.
- 8-pin mini-DIN connector is used.
- Bit rates (bps)

  TX: 110, 600, 4800, 38400

  RX: 110, 600, 4800, 38400
- Number of start bits: 1
- Number of stop bits: 1
- Data length: 8
- Parity: None
- Full duplex/half duplex

(3) Bar code reader

- 3-pole connector
- Power is controlled by software.

(4) Analog input ports

- 2 channels
- Input level: 0 to 2 volts
- Resolution: 6 bits (2 v / 2^6 ≒ 0.03 v)

(5) External speaker

- The output to the built-in speaker can be switched to the external speaker by plugging in a plug into the speaker jack.

(6) System bus

- A total of 50 lines including the 16 address bus lines and 8 data bus lines are available.

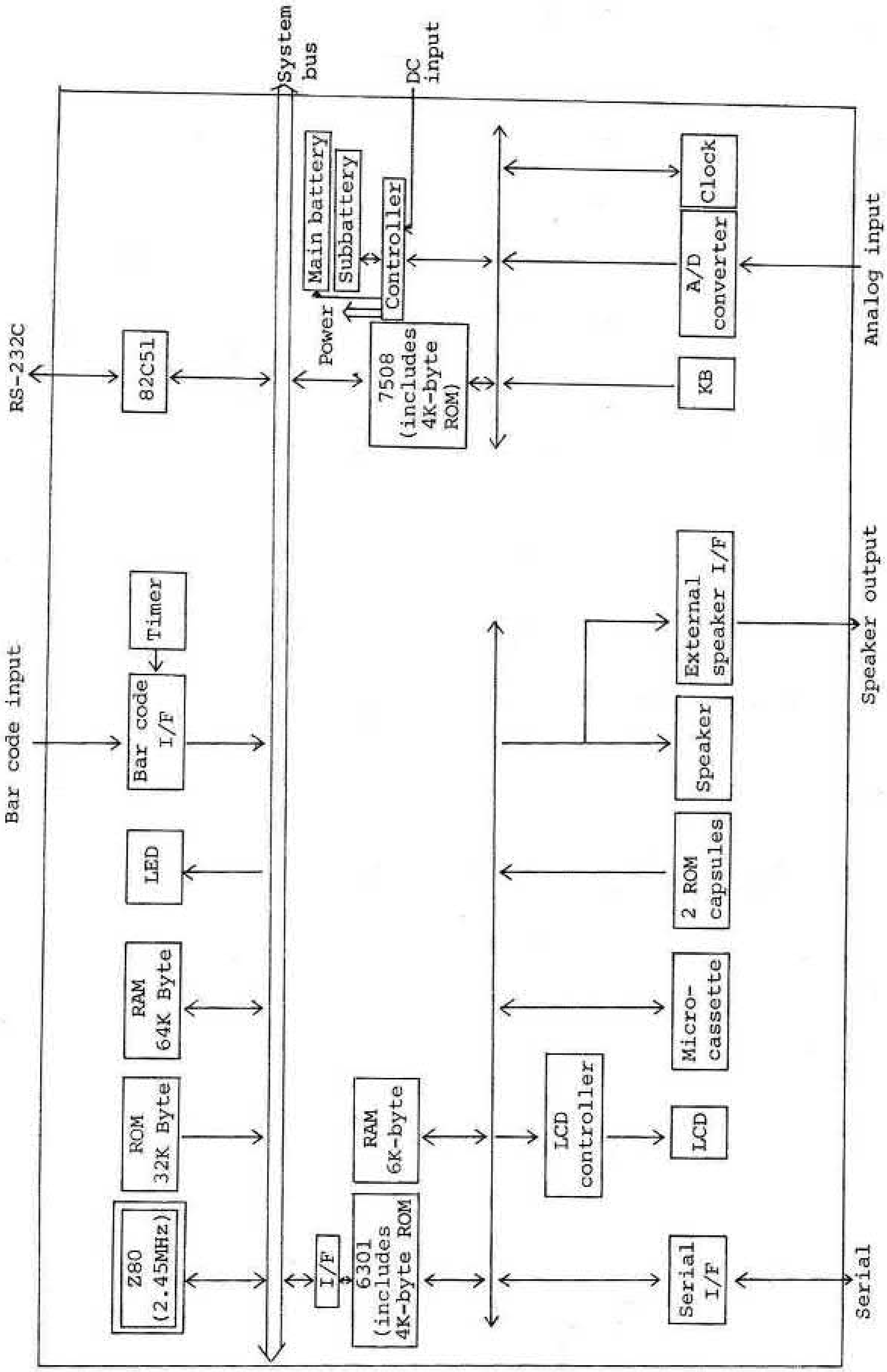
Peripheral Devices Connectable to the External Interface

External Interface	Peripheral	Cable	Options
RS-232C	Printer	#723	P40 P80 Series
		#725	EPSON printers with serial I/F MP(X) series FP(X) series RP(X) series
	Acoustic coupler	#724	CP-20 CX-20 CX-21
	Computer	#726	MAPLE PINE
		#725	QC(X)-20 QC(X)-10
		#738	HC(X)-20

External Interface	Peripheral	Cable	Options
Serial I/F	Minifloppy disk drive	#723	TF-10 TF-15 TF-20
	Microfloppy disk drive	#726	PF-10
	Printer	#723	P40 P80 series
		#725	EPSON printers with serial I/F MP(X) series FP(X) series RP(X) series
Bar code reader I/F	Bar code reader (Wand)		HØØBR code JA (low resolution) HØØBR code HA (high resolution)

External Interface	Peripheral	Cable	Options
System bus	Expansion unit	#727	RAM disk unit Japanese-language unit Modem unit Multi-unit 64 Universal unit

Block Diagram



2.3 Software Features and Organization

2.3.1 Software Features

This subsection lists the features of the MAPLE software.

(1) Industry-standard CP/M 2.2

This allows the user to transport an abundance of commercial CP/M application programs to the MAPLE with relatively little effort.

(2) A variety of peripheral devices supported by OS.

The peripheral devices that MAPLE CP/M 2.2 supports are:

- RAM disk
- ROM capsule
- Mini- and micro-FD
- Microcassette
- Speaker
- Analog input
- RS-232C
- Power
- Clock (calendar)

To support these devices, 25 BIOS entries have been included int the standard CP/M BIOS. Consequently, the user can develop application programs handling these devices with great ease.

The OS, however, supports no bar code equipment. It must be handled by application programs. These programs are also supplied from EPSON.

(3) Many CP/M drives

The table below lists the peripheral devices that are supported as CP/M drivers.

Drive	Peripheral	Capacity		Directories	Maximum tracks/sector
		Total	Data area		
A:	RAM disk	When main RAM is used:	Ø - 23K bytes	16	3 TRK/7 SCT
		When RAM disk is used:			
		6ØK bytes	59K bytes	32	7 TRK/31 SCT
		64K bytes	63K bytes	32	7 TRK/63 SCT
		12ØK bytes	119K bytes	32	14 TRK/63 SCT
		128K bytes	127K bytes	32	15 TRK/63 SCT
B: C:	ROM capsule	Depends on ROM type			
		8K bytes	8K bytes	31	Ø TRK/63 SCT
		16K bytes	16K bytes	31	1 TRK/63 SCT
		32K bytes	32K bytes	31	3 TRK/63 SCT
		Sum of the above capacities when drives B: and C: are used as a contiguous drive.	←		
D: E: F: G:	FD	320K bytes	278K bytes	64	39 TRK/64 SCT

Drive	Peripheral	Capacity		Directories	Maximum tracks/sector
		Total	Data area		
H:	Microcassette	Approx. 3ØK bytes with 3Ø-minute tape	Approx. 3ØK bytes with 3Ø-minute tape	12	Only sequential access in file units is allowed.
I:	ROM capsule in extension unit Supported by a combination of OS ASCII version B or later and a Multi-unit 64.	128K bytes	128K bytes	31	15 TRK/63 SCT
	ROM capsule in extension unit Supported by a combination of Japanese-language OS and a Japanese-language unit.	32K bytes	32K bytes	31	3 TRK/63 SCT

(4) RAM disk features

- Allows both reads and writes.
- High-speed access.
- Provides a storage capacity of 23K bytes maximum when main memory is submitted as RAM disk and a capacity of 128K bytes when an extension unit is installed.
- Data is maintained even when power is turned off.
- The main memory RAM disk is disabled when the extension unit RAM disk is used.

(5) ROM capsule features

- Allows only reads.
- High-speed access
- Provides a storage capacity of 8K bytes (one 2764 chip) to 64K bytes (two 27256 chips).
- Easily installed and removed.

(6) FD features

- Allows both reads and writes.
- High-speed access.
- Provides a large capacity of removable storage.
- Can handle both mini- and micro-floppy disk drives.
- The micro-FD drives (PF-10) is battery driven.

(7) Microcassette

- Allows both reads and writes.
- High-speed access.
- Customized OS allows the user to handle microcassette in the same easy way as FD files.
- Only sequential access is supported.
- Only one file can be open at a time.

(8) Extended unit ROM capsule

- Allows only reads.
- High-speed access
- ASCII OS supports larger capacity than internal ROM capsules.

(9) Devices for software exchange

The user can select any of the following devices for exchanging storage media of different sizes and formats:

- ROM capsule
- FD
- Microcassette

(10) Screen

The MAPLE is provided with a large (80 columns by 8 lines) LCD. Its OS also supports virtual screens as large as 80 columns by 48 lines. The user can switch between four screens, namely, i.e., three text only screens (the 80-column text screen, the 39-column Split screen, and the Dual screen) and one graphics screen, all under software control. In addition to these screens, the Japanese-language OS supports two types of Kanji screens. It also permits switching of virtual screens and control of screen scrolling with function keys.

(11) Clock

The MAPLE has a clock which indicates the year (lowest two digits, month, day, minutes, and second). The clock is battery backed up and performs automatic leap year adjustment.

(12) Password function

The password function protects the MAPLE programs and data from unauthorized accesses. Once a password is defined, this function defers any attempt for a power-on sequence until the operator enters the defined parameter.

(13) Alarm function

The alarm function sounds an alarm at the preset time, whether the MAPLE is in use or not, and displays the predefined messages on the screen. This function can be used for schedule management.

(14) Wake function

The wake function automatically powers on the MAPLE and executes programs in the preprogrammed sequence when the preset time (month, day, and hour) has reached. If the MAPLE is already in on state when the preset time is reached, this function sounds an alarm and displays messages indicating the operating procedure for the programs (alarm function). This function can be used for automatically starting the MAPLE in instrumentation and data gathering applications.

(15) Auto start function

The auto start function performs the steps or programs predefined by the user automatically at power on time. This function will be useful when the MAPLE is used as a dedicated machine.

(16) Menu function

The menu function displays a directory of executable programs on the screen in a menu format at power on or warm boot time. The user can select the program with cursor movement keys and start the selected program by pressing the RETURN key. This function is highly convenient for users who are unfamiliar with operator operations. When a program is already in the TPA, this function causes the program in memory to be immediately executed, thus eliminating the time-consuming program load step.

(17) System display function

The system display function is started by pressing the CTRL and HELP keys simultaneously and displays the system status on the screen. The user can define the parameters for the password, alarm wake, auto start, and menu functions from the screen. The function also allows the user to manually control the microcassette drive.

(18) Hard copy function

The user can take a hardcopy of the current contents of the LCD screen on the printer in one of the following methods:

(1) Pressing the CTRL/PF5 key.

(2) Calling the BIOS hardcopy routine.

Some OS versions do support the hard copy function.

(19) Power off state in restart and continue modes

The MAPLE can be in one of the two power off modes, i.e., restart and continue modes, depending on how the MAPLE is powered off.

- Restart mode: Execution starts at CCP or a menu is displayed when the MAPLE is powered on.
- Continue mode: The processing that were being executed when the MAPLE was powered off is resumed when the MAPLE is powered on again.

(20) Power on/off

The MAPLE can be powered on and off not only through the POWER switch but under program control. The MAPLE can be turned on by the wake function and turned off by a BIOS routine. The user can also set the restart or continue mode. The contents of MAPLE memory are maintained when MAPLE power is turned off.

(21) Auto power off function

The auto power off function automatically turns MAPLE power off in the continue mode when no key entry is made for a predetermined time, thus saving battery power. When the MAPLE is powered on again, executions resumes at the point when the auto power off function is executed.

(22) Voltage drop warning

When the battery voltage drops below approximately 4.7 volts, the OS displays a message "CHARGE BATTERY" on the screen and, in approximately 20 seconds later, automatically turns MAPLE power off. This precludes the contents of the RAM from being completely destroyed or the CPU from hanging up due to the reduced battery voltage level. When this occurs, the active battery is automatically switched to the subbattery which only maintains the power to RAM.

2.3.2 Software Organization

The MAPLE OS resides in the 32K-byte ROM. The OS runs while switching between the RAM and ROM banks. The OS contains the modules listed below.

Module	Function
STARTER	Resides in ROM and performs the following: - System initialize - RESET switch processing - POWER switch processing - Processing of alarm interrupts in power off state.
INTROM	Resides in ROM and processes interrupts from the 7508 and 8251.
MENU	Resides in ROM and controls menu processing.
SYSCRN	Resides in ROM and controls system display processing.
RELOC	Resides in ROM and relocates RAM resident modules from ROM.

Module	Function
BDOS	Resides in ROM and processes CP/M BDOS calls.
PREBIOS	Resides in ROM and perform preprocessing for CP/M BIOS calls.
PSTBIOS	Resides in ROM and perform postprocessing for CP/M BIOS calls.
BIOS1 BIOS2 BIOS3	Resides in ROM and processes CP/M BIOS calls. The BIOS module is divided into three submodules.
SCREEN	Resides in ROM and controls CONOUT BIOS call processing.
MCT	Resides in ROM and controls the microcassette drive.

Module	Function
CCPD	The CCP portion of CP/M in a relocatable format and is relocated into RAM at the beginning of execution.
RBDOSB	The BDOS entry portion of CP/M (main BDOS body resides in ROM) in a relocatable format and is relocated into RAM at the beginning of execution.
RSYSPR	The part of the CP/M BIOS entry portion (main BIOS body resides in ROM) in a relocatable format and is relocated into RAM at the beginning of execution. Includes interrupt handling routines and other system routines.
SYSAR1 SYSAR2 SYSAR3	Copied into RAM and initialize the system work area. There are three modules which are invoked at different timings depending on when the work area is to be initialized.
ROMID	Contains the OS ROM identification.

2.4 MAPLE State Transition

The MAPLE can be in eight states when viewed from the software standpoint. The interrelationship between these eight states is illustrated in the figure on the next page.

MAPLE states

(1) Restart mode power off state

(2) Continue mode power off state

(3) Password entry screen display state

(4) Menu screen display state

(5) System display screen display state

(6) Alarm/wake screen display state

The MAPLE performs no special wake function except it displays messages (strings) indicating operating procedures in the same way as the alarm function when a wake time is reached in the power on state.

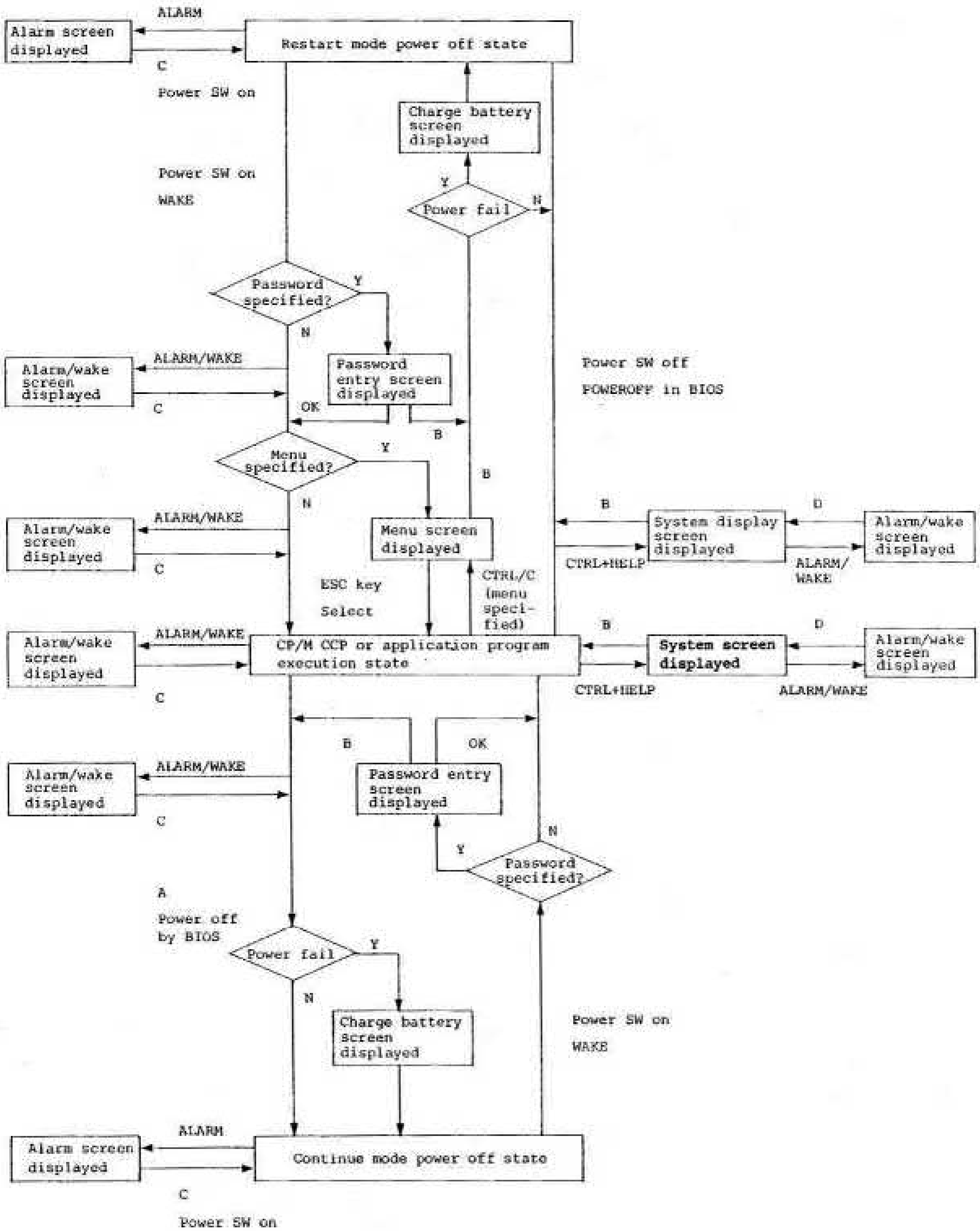
(7) Charge battery screen display state

(8) CCP or application program running state

States 1 through 7 are unique to the MAPLE and only supported by the MAPLE OS.

Note: Power failure refers to a drop in the battery voltage below a specified level.

MAPLE State Transition Diagram



A - CTRL + Power SW off, Auto power off, Power failure
B - A, Power SW off
C - 5Ø seconds, ESC Key, Power SW off, CTRL + Power SW off, Power failure
D - C, Power SW off

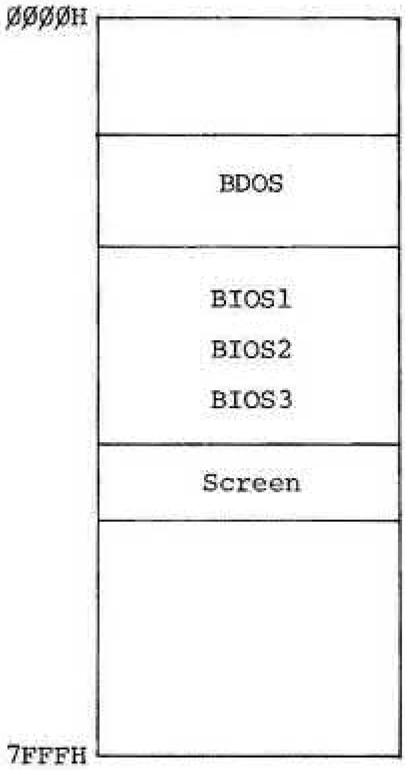
Chapter 3 MAPLE CP/M Principles of Operation

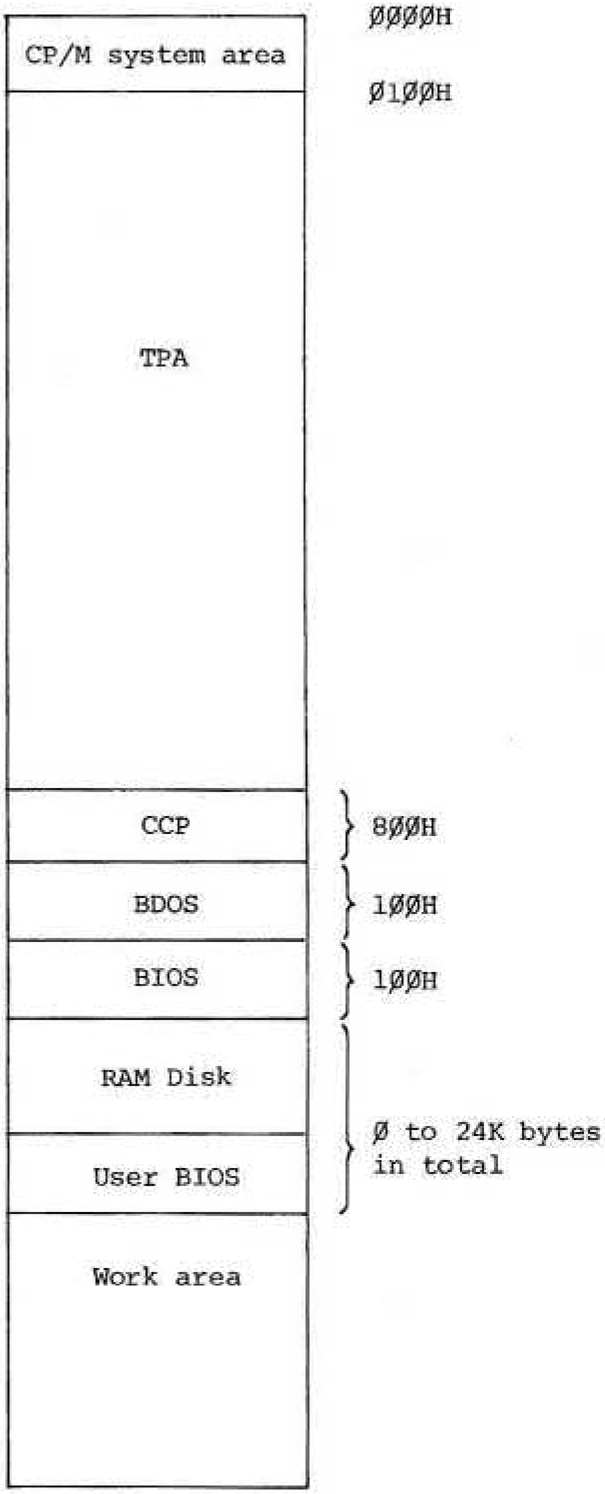
MAPLE adopts CP/M Version 2.2 as its operating system. Since the basic part of the MAPLE operating system is implemented in ROM, MAPLE CP/M runs in a slightly different way from the CP/M for most disk-based computers. This chapter explains how MAPLE CP/M run on the MAPLE computing system.

3.1 CP/M Memory Organization

3.1.1 Roles of CP/M Modules in ROM and RAM

MAPLE CP/M switches between two 32K-byte banks during execution using a bank switching technique as shown in the figure on the next page. One is a ROM bank containing the major portions of CP/M OS and the other is a RAM bank which makes up the first half of the 64K main RAM memory. The CP/M modules (CCP, BDOS, and BIOS) are apparently loaded in RAM as they are on ordinary disk-based computers. This means that MAPLE application programs can use the CP/M functions in the same way as those which use the standard CP/M. In fact, however, only a 100H bytes of a system area containing the entry points to the BDOS and BIOS are loaded in RAM, making the most part of the RAM available for application programs. Actual BDOS and BIOS operations are performed in the OS in ROM that is activated through bank switching. Control is returned to the application program again through bank switching to RAM after processing is terminated.


ØØØØH
BDOS
BIOS1
BIOS2
BIOS3
Screen
7FFFH


ØØØØH
CP/M system area
Ø1ØØH
TPA
CCP
8ØØH
BDOS
1ØØH
BIOS
1ØØH
RAM Disk
User BIOS
Ø to 24K bytes
in total
Work area

The addresses of the CCP, BDOS, and BIOS in RAM differ depending on the total size of the RAM disk implemented and the user BIOS area (0 - 24K bytes). The size of the CP/M system ranges from 59.5K to 45.5K bytes. The RAM disk and user BIOS sizes can be changed by the CONFIG program.

3.1.2 Procedure for Constructing a CP/M System in RAM

On MAPLE, the CP/M system can be loaded from ROM into RAM by three routines: system initialize, reset (CBOOT), and WBOOT. This subsection describes the function of these routines and the timing when they are invoked as well as the interactions between them. The STOP and CTRL/STOP functions for interrupting program execution are also explained here.

The user can take the following measures (must be attempted in this sequence) when his program hangs up:

1. Press the STOP key.
2. Press STOP key while holding down the CTRL key.
3. Press the RESET switch.
4. Hold the SHIFT and GRPH keys simultaneously and press the RESET switch on the side of MAPLE.
5. Press the 75Ø8 RESET switch.

	Operation	Initiated by	When
System initialize	1. Initializes system area 1. 2. Resets the slave CPU 63Ø1. 3. Checks the extended RAM disk unit. 4. Performs system initialization. Sets the year, month, day, hour, minute, and second and the size of the RAM disk and User BIOS. (ASCII Version 1.Ø and Japanese-language OS) 5. In ASCII Version B, the system initialization formats the RAM disk and only initializes the system as follows without performing system initialization: Date and time: 19ØØ/ØØ/ØØ ØØ:ØØ:ØØ Sunday RAM DISK: 9K bytes User BIOS: Ø bytes	1. Pressing the 75Ø8 RESET switch. 2. Holding the SHIFT and GRPH keys down and pressing the RESET switch.	1. Using the system for the first time after purchase. 2. 75Ø8 hangs up. 3. The extension unit is installed or removed.
Reset	1. Initializes system area 2. 2. Resets the slave CPU 63Ø1. 3. Loads the BIOS to RAM. 4. Checks the RAM disk checksum. 5. Sets the screen to the mode specified by CONFIG.	1. Pressing the RESET switch.	1. Z8Ø hangs up. 2. 63Ø1 hangs up.
WBOOT	1. Flushes the FD buffer. 2. Sets the cursor to the mode set up by CONFIG.	1. Entering C or the STOP key in CCP mode. 2. Sending control to WBOOT in the program. 3. Turning power on in restart mode.	1. Control jumps to BIOS WBOOT.

	Operation	Initiated by	When
CTRL/STOP	1. Interrupts the current I/O operation. 2. Clears the key buffer and loads it with Ø3H.	1. When holding down the CTRL key and pressing the STOP key.	1. Interrupting application program performing an I/O operation. The application program must terminate on receiving Ø3H.
STOP	1. Clears the key buffer and loads it with Ø3H.	1. Pressing the STOP key.	1. When interrupting the application program must terminate on receiving Ø3H.

Relationships among the system initialize, reset, and WBOOT

System initialize

75Ø8 is reset.
SHIFT/GRPH + RESET

↓

Reset

RESET switch

↓

BOOT

1. Sets the currently logged in drive to A:.
2. Sets the I/O byte to A9H.
3. Displays the CP/M sign-on message.
4. Sets the keyboard and character set types according to the DIP switch settings.

- Execution jumps to WBOOT.
- Power is turned on in restart mode.

WBOOT

↓

Actions common to BOOT and WBOOT

1. Turns RS-232C power off.
2. Turns ROM capsule power off.
3. Stops the micro cassette.
4. Creates the BIOS and BDOS jump vectors in the CP/M system area.
5. Loads BDOS to RAM.

↓

Loads CCP to RAM and transfers control to CCP or the menu display routine.

System areas 1, 2, and 3

The RAM work area that MAPLE uses is classified into the following two types:

1. Work areas initialized at a specific timing before use.
2. Work areas used only temporarily.

The work area of the first type is divided into three types called system areas 1, 2, and 3 according to the timing at which initial values are set.

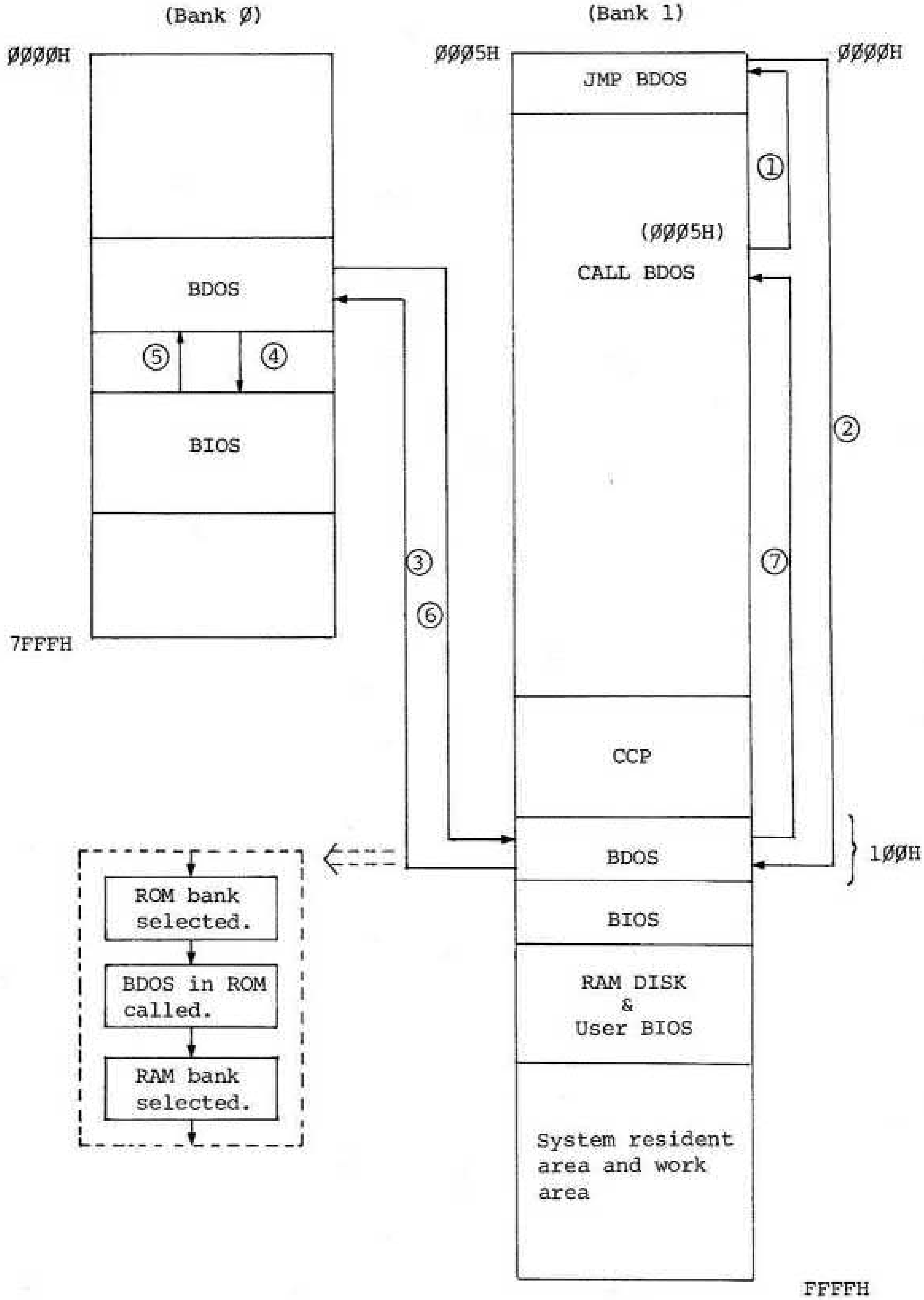
	Initialized when	Work area contents
System area 1	System initialize is invoked.	Initial values of flags indicating PASSWORD and MAPLE basic status.
System area 2	Reset is invoked.	Initial values related to BIOS.
System area 3	WBOOT is invoked.	Initial values related to BDOS.

3.2 BDOS Function Processing Flow

When BDOS is called by a MAPLE application program, control is first transferred to the entry point to the BDOS in RAM. Then the OS switches banks and maps the memory addresses 0000H to 7FFFH into ROM, then calls the real BDOS in ROM. Upon completion of processing, the OS switches the bank to RAM and returns control to the application program with return information loaded in registers.

The BDOS in ROM calls directly the BIOS in ROM.

BDOS call processing flow



3.3 BDOS Error Recovery Procedure

BDOS can display four types of error conditions. Since these errors are handled totally under BDOS control, it is likely that they destroy the current screen image, initiates a warm boot on receipt of user response from the keyboard after the error display, or even destroy memory data. One of countermeasures to avoid this is to make the application program report and handle error conditions for itself. The MAPLE OS permits the application program to take the following two measures against error conditions to achieve this:

1. Receiving BDOS error information as a return code.
2. Rewriting the jump vector for BDOS error processing and performing user-supplied error processing.

The four types of BDOS errors are:

1. Bad Sector
2. Bad Select
3. R/O Disk
4. R/O File

3.3.1 Receiving BDOS Error Information in Return Code

(1) Changing the BDOS error reporting mode

The application program can receive any BDOS error information directly in CPU registers by calling location 0012H (SET ERROR) in OS ROM (bank 0). It can also have BDOS return any error information by calling location 0015H (RESET ERROR) in OS ROM.

The application program must use BIOS CALLX (WBOOT + 69H) to directly call a routine in OS ROM. In this case, the program must reserve a stack area at a location 8000H or higher in RAM.

(2) Return codes

Error \ Register	A	H	
BAD SECTOR	FFH	Ø1H	Standard CP/M BDOS errors
BAD SELECT	FFH	Ø2H	
R/O DISK	FFH	Ø3H	
R/O FILE	FFH	Ø4H	
MCT ERROR	FFH	Ø5H	BDOS errors unique to MCT

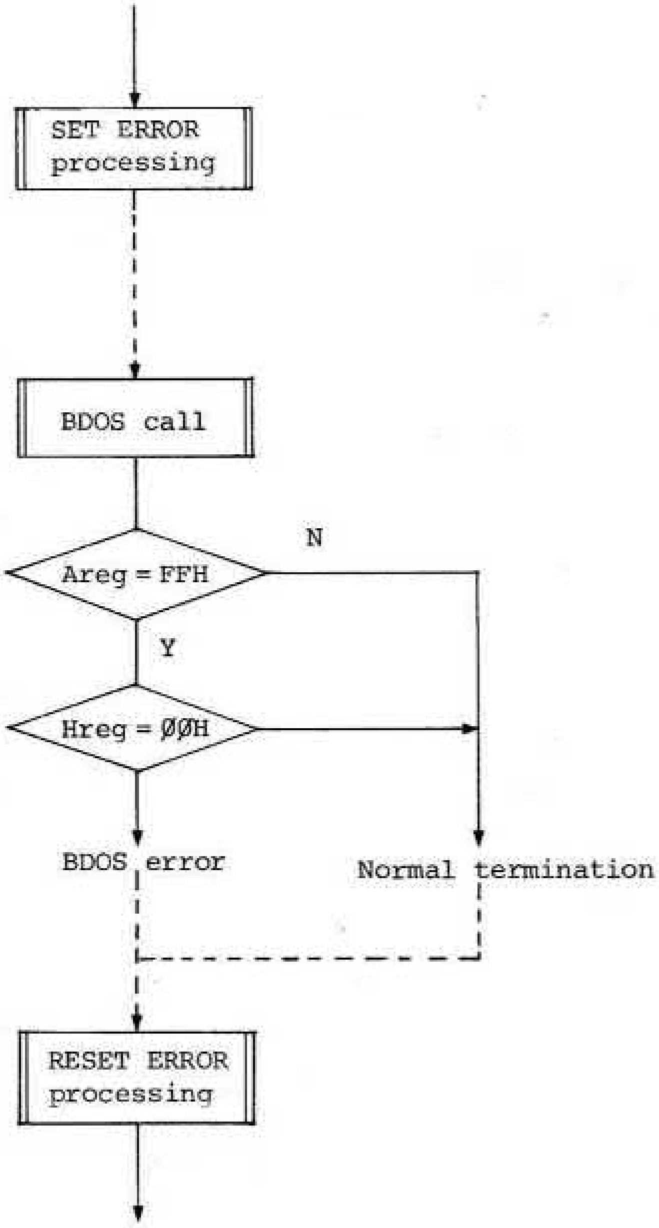
For Bad Sector errors, BDOS stores more detailed error information in memory.

BIOSERROR EQU 0F536H

Data in memory	Error type	
Ø1H	Read error	
Ø2H	Write error	
Ø3H	Write protected.	←Write protected
Ø4H	Timeout	
Ø5H	Seek error	(MCT only)
Ø6H	CTRL/STOP pressed.	(MCT only)
Ø7H	Power turned off.	

(3) Procedure for identifying errors

Some of the BDOS functions returns 0FFH to the A register as a usual return code. Therefore, the calling program must identify errors by examining the H register as well as the A register. See the figure below.



(4) Programming notes

1) Once SET ERROR is executed, BDOS performs no error processing and continues only to return error status until a RESET ERROR or WBOOT is executed.

2) After execution of SET ERROR, the results are not guaranteed unless the application program performs its own error checking and recovery processing.

3.3.2 Rewriting the Jump Vector for Processing BDOS Errors

Four jump vectors for processing BDOS errors are located at the beginning of BDOS in RAM. The application program can handles error conditions in its own way by changing the contents of these jump vectors.

```
ERRVCTR: <-----------------
             Address ((Contents of RAM addresses 6 and 7)+3)
   DW  PERERR <---- Address of parameter error processing routine
                      (Bad Sector error)
   DW  SELERR <---- Address of select error processing routine
                      (Bad Select error)
   DW  RODERR <---- Address of read only disk error processing
                    routine (R/O Disk error)
   DW  ROFERR <---- Address of read only file error processing
          ^         routine (R/O File error)
          |
```

The application program can perform its own error processing by changing the above addresses.

Programming notes:

(1) On return, the stack area is switched to that for the application program because the stack area for the BDOS was used during BDOS processing.

(2) Bank 1 is selected (all RAM).

(3) The user error processing routine must contain no BDOS calls if it is to return control to BDOS with a RET statement.

3.4 BIOS Function Operation Flow

(1) Outline

The major BIOS operations are carried out by BIOS in ROM as BDOS operations are. To achieve these, when a call to BIOS is made from an application program, the OS receives the call in the BIOS in RAM, switches the active bank to the system bank, and calls the BIOS in the system bank (ROM). After completion of the BIOS processing, the OS returns to the BIOS in RAM with various return information and result data, switching again to the user bank, and returns control to the application program.

The BIOS in RAM always resides in addresses higher than 8000H so that it is not affected by bank switching.

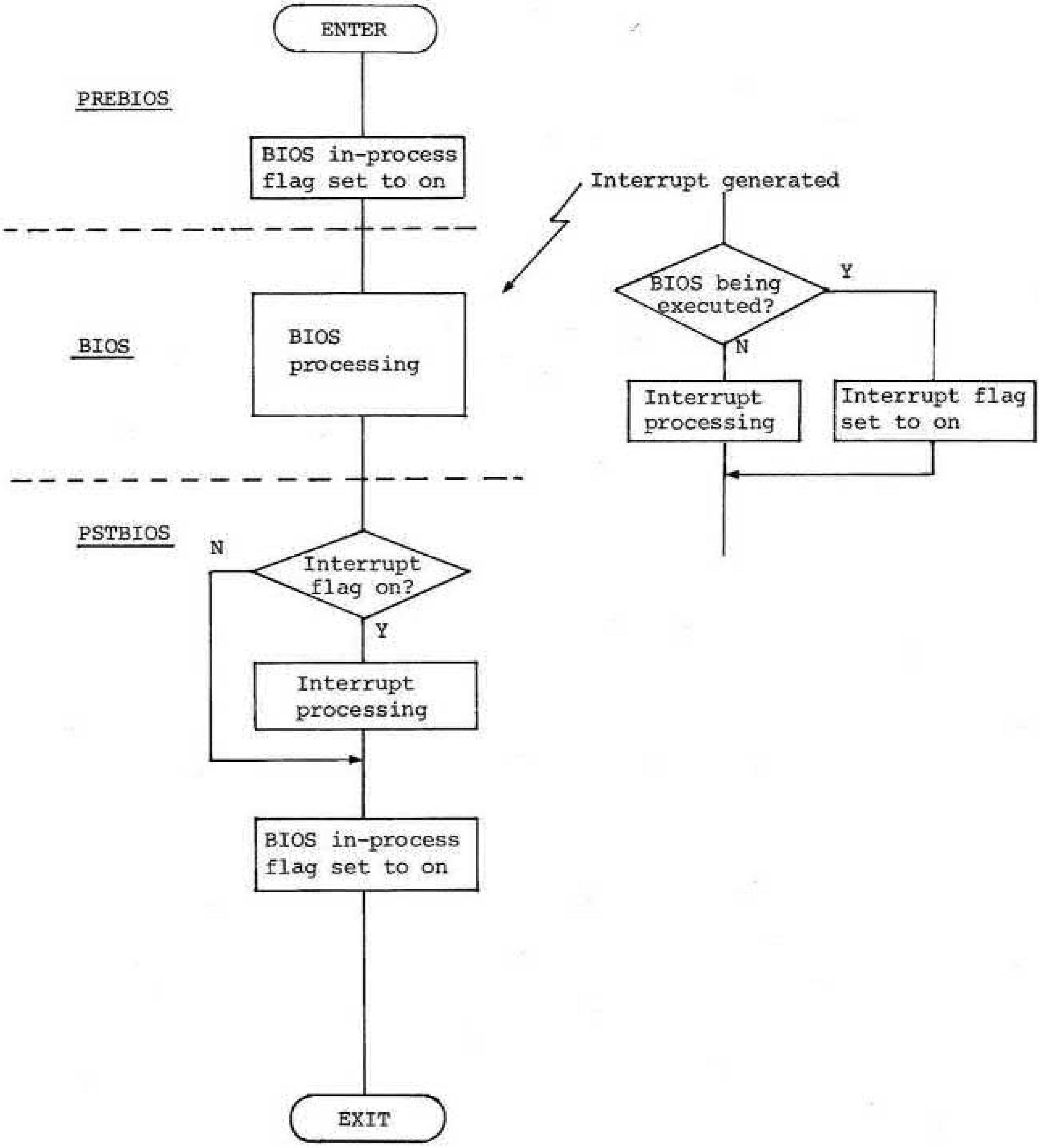
(2) PREBIOS and PSTBIOS

Some BIOS routines uses the slave CPU functions (e.g., screen and microcassette handling). Since the main and slave CPUs communicate commands and data using a specific protocol, if the main CPU attempts to request the slave CPU to do one operation while it has already instructed the slave CPU to do another operation, the protocol will be destroyed and the communication between the main and slave CPUs hang up. BIOS controls the slave CPU properly while BIOS alone is using the slave CPU. If, however, an interrupt is generated which calls for a service by the slave CPU (e.g., alarm, power off, or power failure interrupt), it will try to have the interrupt source use the slave CPU, ignoring the execution sequence established between the main and slave CPU, causing the MAPLE to hang up.

PREBIOS and PSTBIOS are provided to solve this problem. When a call is made to BIOS, the OS executes PREBIOS to set on a flag indicating that BIOS processing is in progress. If an interrupt requesting for a slave CPU service is generated while this flag is on, the interrupt handling routine checks this flag and, knowing that the slave CPU is used by a BIOS routine, makes the interrupt-driven processing pending after turning on a flag indicating that an interrupt is held pending.

When the BIOS processing is completed, the OS starts PSTBIOS, which in turns executes any pending interrupt routines, clears the flag indicating the execution of a BIOS routine, and returns control to the application program.

The flowchart on the next page shows the relationship between PREBIOS, PSTBIOS, and BIOS processing.


ENTER
PREBIOS
BIOS in-process flag set to on
Interrupt generated
BIOS being executed?
Y
N
BIOS
BIOS processing
Interrupt processing
Interrupt flag set to on
PSTBIOS
N
Interrupt flag on?
Y
Interrupt processing
BIOS in-process flag set to on
EXIT

(3) Calling a BIOS routine from an application program

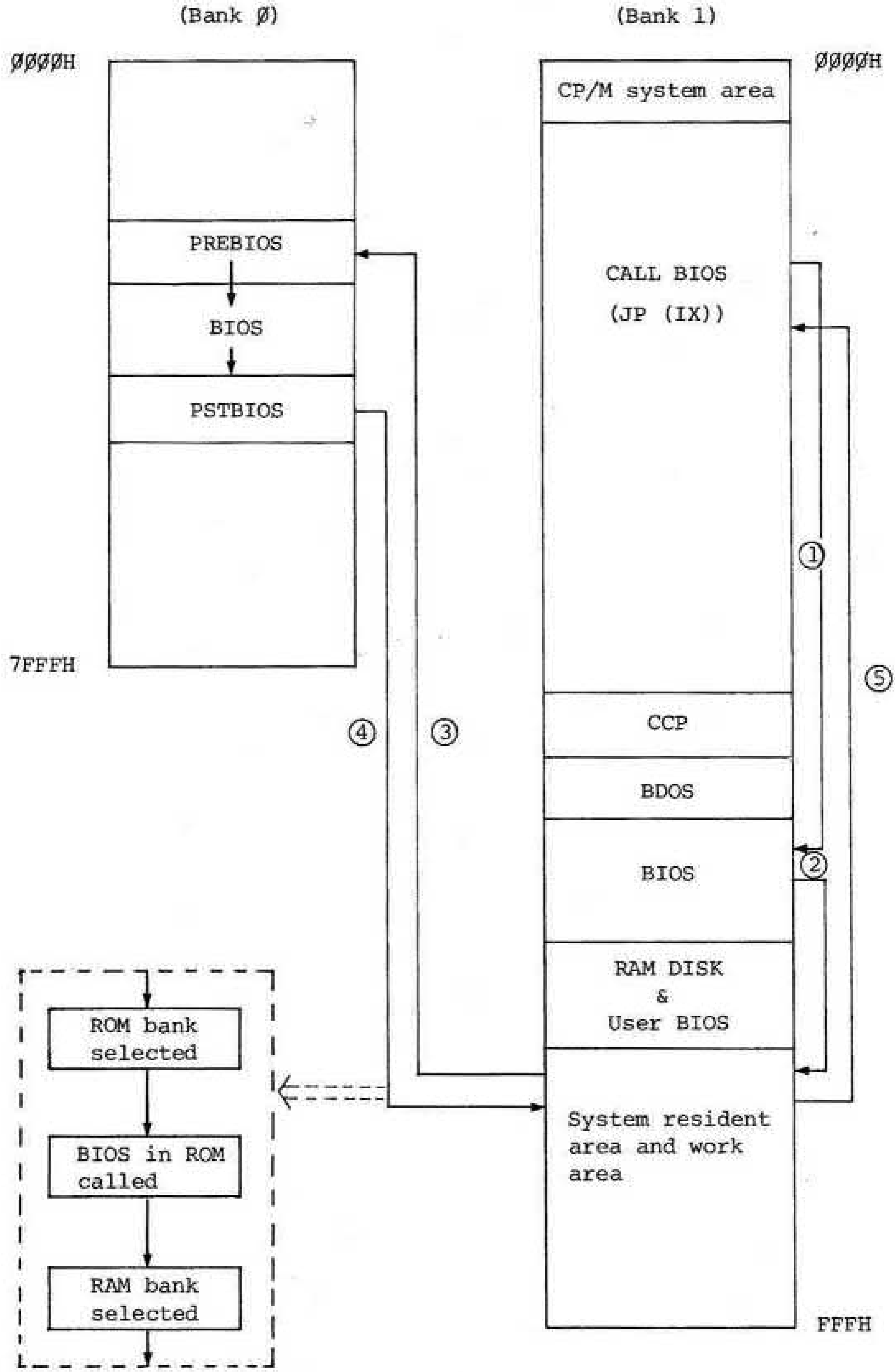
The entry address into the BIOS WBOOT in RAM is located in addresses 1 and 2 in RAM. To use a BIOS call, the user program must call BIOS specifying the address obtained by adding the function offset to this BIOS entry address. Since every BIOS routine ends with a RET statement, control returns the statement immediately following the CALL statement that called the BIOS routine.

SAMPLE PROGRAM

The sample program below calls a BIOS routine with the function's offset from the WBOOT (multiple of 3) in the IX register pair.

```
BIOS:
        PUSH    BC
        LD      BC, (0001H)   ;Entry point to WBOOT.
        ADD     IX, BC
        POP     BC
        JP      (IX)          ;Jump to BIOS.
```

(4) BIOS call operation flow



Chapter 4 BIOS Subroutines

MAPLE BIOS is greatly extended for support of a number of I/O functions. In fact, it contains as many as 44 subroutines. This chapter gives a detailed description of these subroutines. The BIOS CONOUT routine has many options, and therefore, a whole chapter is reserved for it for full description of the function (see Chapter 5).

* Programming Notes on the use of BIOS calls

1) The entry to each function is indicated by the offset from WBOOT. Find its effective address by adding this offset to the entry address to the WBOOT located in 01H and 02H.

2) Save the contents of registers if necessary because the contents of the registers except those for receiving the return parameter are not guaranteed.

The entry addresses and functions of BIOS Subroutines

Offset from WBOOT	ENTRY NAME	Function
-Ø3H	BOOT	Performs a cold BOOT.
±ØØH	WBOOT	Performs a warm BOOT.
+Ø3H	CONST	Returns the console input status.
+Ø6H	CONIN	Inputs one character from the console.
+Ø9H	CONOUT	Outputs one character to the console.
+ØCH	LIST	Outputs one character to the LIST device.
+ØFH	PUNCH	Outputs one character to the PUNCH device.
+12H	READER	Inputs one character from the READER device.
+15H	HOME	Positions the disk head to track ØØ.
+18H	SELDSK	Specifies the device.
+1BH	SETTRK	Specifies the track for read or write.
+1EH	SETSEC	Specifies the sector for read or write.
+21H	SETDMA	Specifies the DMA starting address for read or write.
+24H	READ	Reads the specified sector.
+27H	WRITE	Writes data to the specified sector.
+2AH	LISTST	Returns the status of the list device.
+2DH	SECTRN	Translates a logical sector to a physical sector.
+3ØH	PSET	Converts graphics screen data for display.
+33H	SCRNDUMP	Takes a hard copy of the displayed data.
+36H	BEEP	Sounds the speaker.
+39H	RSOPEN	Opens the RS-232C interface.

Offset from WBOOT	ENTRY NAME	Function
+3CH	RSCLOSE	Closes the RS-232C interface.
+3FH	RSINST	Informs whether the RS-232C interface has received data.
+42H	RSOUTST	Checks whether the RS-232C interface is ready for transmission
+45H	RSIN	Receives one character from the RS-232C interface.
+48H	RSOUT	Transfers one character to the RS-232C interface.
+4BH	TIMDAT	Performs clock or alarm functions.
+4EH	(MEMORY)	Does nothing.
+51H	RSIOX	Performs RS-232C functions.
+54H	(LIGHTPEN)	Does nothing.
+57H	MASKI	Sets or resets the interrupt mask.
+5AH	LOADX	Reads the data in the specified bank.
+5DH	STORX	Writes data into the specified bank.
+6ØH	LDIRX	Transfers data between banks.
+63H	JUMPX	Jumps to the specified bank address
+66H	CALLX	Calls the subroutine at the specified bank address.
+69H	GETPFK	Gets a PF key.
+6CH	PUTPFK	Defines a PF key.
+6FH	ADCVRT	Performs analog data input operations.
+72H	SLAVE	Processes communication with the SLAVE CPU 63Ø1.
+75H	RDVRAM	Reads the contents of VRAM.
+78H	MCMTX	Processes communication with MIOS.

Offset from WBOOT	ENTRY NAME	Function
+7BH	POWEROFF	Turns main power off.
+7EH	USERBIOS	Entry point to the User BIOS.

Entry Name	BOOT	Entry Address	WBOOT - 03H
Function	Performs a CP/M cold boot.		
Entry parameter	None.		
Return parameter	None.		
Explanation			

BOOT is entered by a 7508 or system initialize reset (SIFT/GRPH/RESET), or the depression of the RESET key. This routine is used not by application programs but by the operating system.

BOOT performs the following:

1. Sets the current drive to A:.
2. Sets the I/O byte to 10101001B.

    LST: = LPT: (RS-232C)

    PUN: = UP1: (RS-232C)

    RDR: = UR1: (RS-232C)

    CON: = CRT: (Output: LCD, Input: Keyboard)

3. Displays the CP/M sign-on message.

4. Reads informations of the DIP switches and saves their settings in a work area to identify the keyboard (nationality) and the character set to be used.
5. Loads the CTRL/HELP entry in the keyboard subroutine table with the system display address and the CTRL/PF5 entry with the hardcopy address.
6. Sets the pointer to the PF key table to the system table.
7. Initializes the cursor movement key (arrowed key) codes.
8. Jumps to the routine shared with WBOOT.

Entry Name	WBOOT	Entry Address	WBOOT ±0H
Function	Performs a CP/M warm boot.		
Entry parameter	None.		
Return parameter	None.		
Explanation			

WBOOT is entered when power is turned on in restart mode or a JUMP 0 is executed.

WBOOT performs the following:

1. Writes the write data left in the FDD buffer into the floppy disk.
2. Initializes the MCT parameters.
3. Restores the cursor into the state defined by CONFIG.
4. Sets the pointer to the PF key table to the system table.
5. Displays the PF key definitions on line 8 when PF key display mode is specified.

The following processing is common to WBOOT and BOOT:

6. Sets SP to the value for BIOS.

7. Turns the RS-232C interface power off.

   Turns the ROM capsule power off.

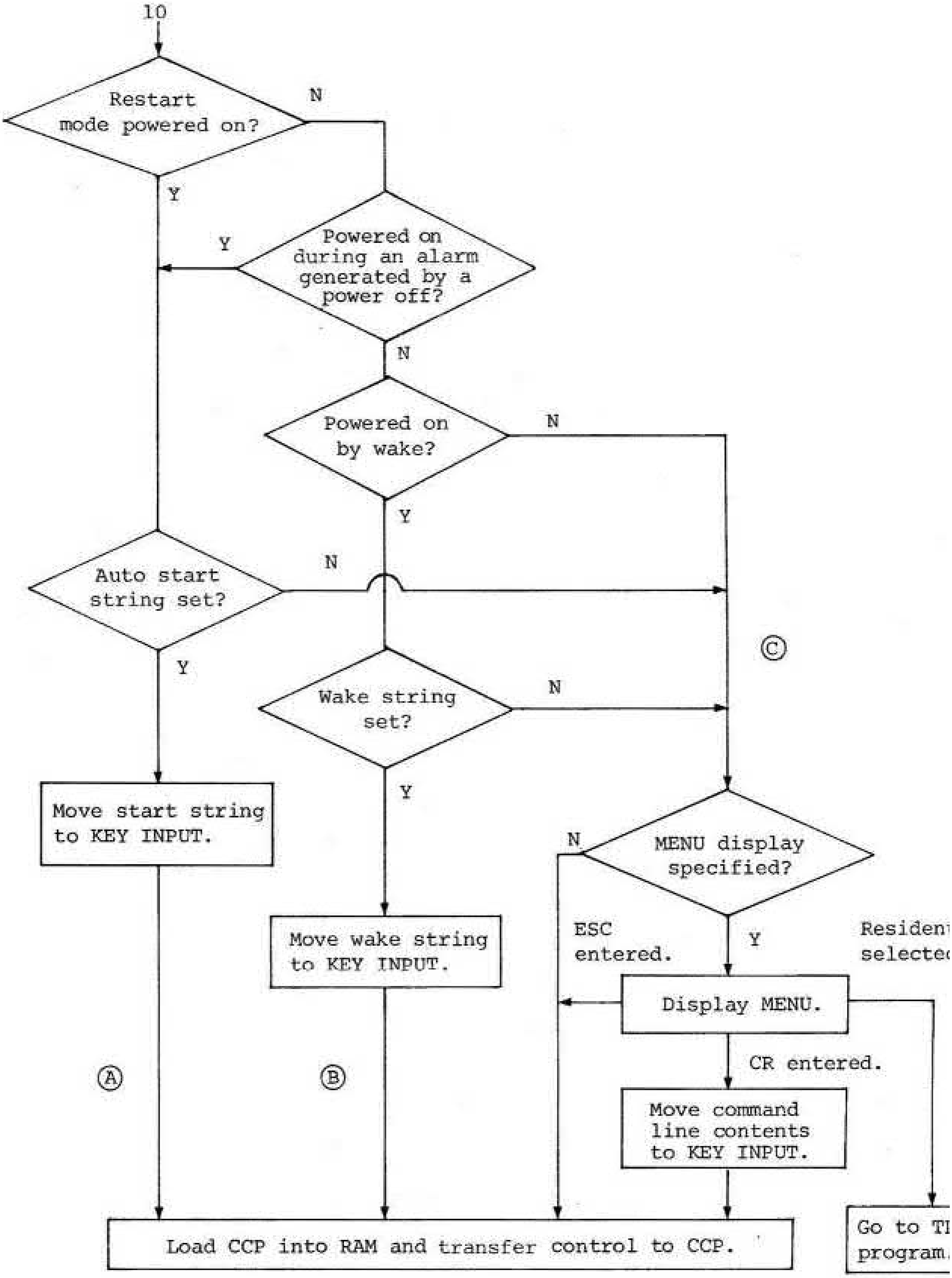
   Stops the microcassette.

8. Loads addresses Ø to 2 with the object code of JP WBOOT.

   Loads addresses 5 to 7 with the object code of JP BDOSE.
   (BDOSE → RAM BDOS starting address + 6)

9. Loads BDOS into RAM.

The subsequent actions of WBOOT depends on the system conditions under which it has executed so far. The actions are shown in the flowchart on next page.


10
Restart mode powered on?
N
Y
Y
Powered on during an alarm generated by a power off?
N
Powered on by wake?
N
Y
Auto start string set?
N
Y
Ⓒ
Wake string set?
N
Y
Move start string to KEY INPUT.
N
MENU display specified?
Move wake string to KEY INPUT.
ESC entered.
Y
Resident selected
Display MENU.
CR entered.
Ⓐ
Ⓑ
Move command line contents to KEY INPUT.
Load CCP into RAM and transfer control to CCP.
Go to T program.

A: When an auto start string is specified and

- The power switch is turned on.
- The power switch is turned on while an alarm generated in the power off state is being displayed.

B: When power is turned on by wake with a wake string specified.

C: - After BOOT is executed.

- After WBOOT is executed.
- When power switch is turned on by wake with no wake string specified.

Entry Name	CONST	Entry address	WBOOT + Ø3H
Function	Returns the status of the console.		
Entry parameter	None.		
Return parameter	A = ØØH: Console input buffer is empty. A = ØFFH: Data is present in console input buffer.		
Explanation			

CONST checks the CON: field (bits Ø and 1) of the I/O byte (at address 3) to determine whether the console input device is the keyboard or RS-232C interface and returns the status of the console.

CON: Bit 1	Bit Ø	
Ø	Ø	Indicates whether the keyboard buffer is empty.
Ø	1	
1	Ø	Indicates whether the RS-232C receive buffer is empty.
1	1	

Entry Name	CONIN	Entry address	WBOOT + Ø6H
Function	Returns one character read from the console.		
Entry parameter	None.		
Return parameter	When YPFCMFLG ≒ ØFFH A = ASCII code When YPFCMFLG = ØFFH C = ØØH --> A = ASCII code C = ØFFH --> A reg. contains one of ØEØH through ØE9H which correspond to PF1 through PF9.		
Explanation			

CONIN checks the CON: field of the I/O byte like CONST, and receives one character from the keyboard or RS-232C interface. This routine waits until a character is received.

(1) When the keyboard is assigned to the console (I/O byte, bits 1 and 0 are 00 or 01)

CONIN operates in different ways depending on the state of YPFCMFLG (at 0F108H) which controls the handling of the PF keys.

1) When YPFCMFLG ≒ FFH

When a PF key is pressed, CONIN returns the string defined for that PF key. Consequently, CONIN cannot determine what PF key is pressed. When a key other than PF keys is pressed, CONIN returns the corresponding ASCII code.

2) When YPFCMFLG = ØFFH

CONIN returns via the C reg. the information as to whether a PF key is pressed.

- When C = ØØH

Indicates that a key other than PF keys is pressed and the corresponding ASCII code is placed in the A reg.

- When C = ØFFH

Indicates that a PF key is pressed. The A reg. contains either one of EØH through E9H which correspond to PF1 through PF9.

YPFCMFLG is set by directly rewriting the work area or by writing ESC + ØBØH or ESC + ØB1H through the CONOUT routine.
CONIN waits until input data is received. When the auto power off time expires, however, power is automatically turned off during the CONIN routine in the continue mode. When power is turned on again, execution resumes at the CONIN wait state.

(2) When the RS-232C interface is assigned to the console (I/O byte, bits 1 and 0 are 10 or 11)

CONIN places the data received from the RS-232C interface into the A reg. When no data is present at the RS-232C interface, CONIN waits until data is received. The operation of this routine is identical to that of RSIN.

Entry Name	CONOUT	Entry Address	WBOOT + Ø9H
Function	Outputs one character to the console.		
Entry parameter	C = output data		
Return parameter			
Explanation			

See Chapter 6 for details.

Entry Name	LIST	Entry Address	WBOOT + ØCH
Function	Outputs one character to the list device.		
Entry parameter	C = output data		
Return parameter	None		
Explanation			

LIST checks the LST: field (bits 7 and 6) of the I/O byte and sends one character to the corresponding device.

I/O byte

Bit 7	Bit 6		
Ø	Ø	(TTY):	Outputs to the serial port.
Ø	1	(CRT):	Outputs to the LCD (LIST operates in the same way as CONOUT).
* 1	Ø	(LPT):	Outputs to the RS-232C interface (LIST operates in the same way as RSOUT). LIST waits until DSR and TxRDY are set to 1 indicating that the counterpart receiver is ready for reception.

1 1 (UL1): Does nothing.

*: Default setting.

When the I/O byte is set to serial or RS-232C interface and LIST is used for the first time after WBOOT, LIST outputs the command ESC + "R" + x to select the character set corresponding to the country currently set before sending the output data.

Entry Name	PUNCH	Entry Address	WBOOT + ØFH
Function	Outputs one character to the punching device.		
Entry parameter	C = output data		
Return parameter	None		
Explanation			

PUNCH checks the PUN: field (bits 5 and 4) of the I/O byte and sends one character to the corresponding device.

I/O byte

Bit 5	Bit 4		
Ø	Ø	(TTY):	Does nothing.
Ø	1	(PTP):	Outputs to the LCD (operates in the same way as CONOUT).
* 1	Ø	(UP1):	Outputs to the RS-232C interface (operates in the same way as RSOUT). PUNCH waits until DSR and TxRDY are set to 1 indicating that the counterpart receiver is ready for reception.

1	1	(UP2): Does nothing.

*: Default setting.

Entry Name	READER	Entry Address	WBOOT + 12H
Function	Inputs one character from the reader device.		
Entry parameter	None.		
Return parameter	A = input data.		
Explanation			

READER checks the RDR: field (bits 3 and 2) of the I/O byte and reads one character from the corresponding device. When no input data is present, READER waits until data is received.

I/O byte

Bit 3	Bit 2	
Ø	Ø	(TTY): Reads from the keyboard (operates in the same way as CONIN).
Ø	1	(PTP): Does nothing.
1	Ø	(UP1): Reads from the RS-232C interface (operates in the same way as RSIN).
1	1	(UP2): Does nothing.

In OS ASCII versions B and later, READER always returns 1AH (EOF) when the PTR or UR2 is selected.

Entry Name	HOME	Entry Address	WBOOT + 15H
Function	Positions the disk head to track ØØ.		
Entry parameter	None.		
Return parameter	None.		
Explanation			

HOME writes the write data left in the FDD buffer into the floppy disk and moves the disk head to track ØØ.

Entry Name	SELDSK	Entry Address	WBOOT + 18H
Function	Specifies the drive.		
Entry parameter	C = logical drive No. 00H = A: --> 08H = I: Bit 0 of the E reg. indicates whether the drive is to be accessed for the first time after WBOOT. Bit 0 = 0: The first access after WBOOT. Bit 0 = 1: Not the first access after WBOOT.		
Return parameter	HL = 0000H: Parameter error. HL ≠ 0000H: Normal termination. HL contains the DPE (disk parameter header) address of the physical drive corresponding to the logical drive.		
Explanation			

Entry parameters 00H through 08H correspond to the logical drives A: through I:, respectively. Since the correspondence between the logical drives A: through G: and the actual physical drives is not fixed, SELDSK specifies the drive after translating the logical drive into the physical drive. (See "Changing Drives" for details about logical and physical drives.)

SELDSK sets or resets bit 0 of the E reg. to indicate whether the drive is to be accessed for the first time. When bit 0 = 0, SELDKS takes the following actions according to the selected physical drive:

1. RAM DISK (Default logical drive is A:.)
   Does nothing.
2. ROM capsule (Default logical drives are B: and C:.)
1) Turns the ROM capsule power on.
2) Checks whether the 2 bytes of the ROM header contains 0E5H and 37H to determine whether ROM is actually installed and whether the ROM is for ROM capsules. A parameter error is signaled if an error occurs.
3. FDD (Default logical drives are D:, E:, F:, and G:.)
1) Opens the serial port for communication and turns the drive power on.
2) If the write buffer has been already loaded with write data, SELDSK writes the data onto the FD.
   Example: ON the TF-20 which contains two drives, if drive E: is specified when the preceding write data for drive D: is only placed in the buffer but not actually written on the FD, SELDSK flushes out the buffer before designating drive E:.
3) Otherwise, SELDKS issues the RESET command to the FDD.
   Once the FDD buffer is cleared through operation 2) or 3), the

FDD can be used with the newly specified drive designation. A parameter error will be reported if an error occurs during the above processing; e.g., the serial port cannot be opened or the RESET command is terminated abnormally (no FDD is installed or no floppy disk is inserted).

4. Microcassette drive (Default logical drive is H:.)

   Does nothing.

5. ROM capsule in the extended unit (Default logical drive is I:.)

1) Checks whether the extended unit is installed.
2) Checks whether ROM is installed in the ROM capsule in the extended unit and whether the 2 bytes of the header are ØE5H and 37H which identify the ROM for ROM capsules.

   A parameter error will be signaled if an error occurs during operation 1) or 2).

Entry Name	SETTRK	Entry Address	WBOOT + 1BH
Function	Specifies the track for read or write.		
Entry parameter	BC = track No.		
Return parameter	None.		

Explanation

The following track numbers can be specified depending on the drive type:

Physical drive	Logical drive	Track No.
RAM DISK	A:	Ø - 2: Internal RAM disk Ø - 7: 6ØK RAM disk unit Ø - 7: 64K RAM disk unit Ø - 14: 12ØK RAM disk unit Ø - 15: 128K RAM disk unit
ROM capsule	B: C:	Ø - 7
FDD	D: E:	Ø - 39

	F: G:	
MCT	H:	Ø - 4
ROM capsule in extended unit	I:	Ø - 15

Since SETTRK makes no entry parameter check, it reports no error even if a truck number outside the valid range is specified. An error will be reported when an actual read or write operation is performed.

Entry Name	SETSEC	Entry Address	WBOOT + 1EH
Function	Specifies the sector for subsequent read or write.		
Entry parameter	BC = sector No. (Ø - 63)		
Return parameter	None.		
Explanation			

Valid sector numbers are Ø through 63. Although SETSEC does not check the entry parameter, an error will be signaled when an actual read or write is performed if a sector number beyond that range is specified.

Entry Name	SETDMA	Entry Address	WBOOT + 21H
Function	Specifies the DMA starting address for read or write.		
Entry parameter	BC = DMA starting address.		
Return parameter	None.		
Explanation			

SETDMA specifies the starting address of the area to be used as the memory buffer during read or write. Data is read from or written onto the drive in 128 byte (1 sector) units.

Entry Name	READ	Entry Address	WBOOT + 24H
Function	Reads the specified sector.		
Entry parameter	None.		
Return parameter	A = 00H: Normal termination. A ≠ 00H: Abnormal termination.		
Explanation			

READ reads the sector specified by SELDSK, SETTRK, and SETSEC and stores the contents in the 128 byte area starting at the address specified by SETDMA.

If the drive is FDD (D:, E:, F:, G:), one of the following codes is returned when an error occurred:

- FAH: Read error.
- FBH: Write error.
- FCH: Select error.
- FDH: Read only disk.
- FEH: Read only file.

Only 0FAH or 0FCH is returned by READ.

An error will be generated if a READ is executed for MCT (H:). Use MIOS subroutines for MCT.

Entry Name	WRITE	Entry Address	WBOOT + 27H
Function	Writes the data to the specified sector.		
Entry parameter	C = Specifies how to write. ØØH: Write standard format data (write after blocking). Ø1H: Write unblocked data (write immediately without blocking). Ø2H: Write to a sequential file.		
Return parameter	A = ØØH: Normal termination. A ≠ ØØH: Abnormal termination.		
Explanation			

WRITE writes the data from the 128 byte area starting at the address specified by SETDMA into the sector specified by SETTRK and SETSEC.

If the drive is FDD (D:, E:, F:, G:), one of the following codes is returned when an error occurred:

FAH: Read error.
FBH: Write error.
FCH: Select error.
FDH: Read only disk.
FEH: Read only file.

} Only ØFBH, ØFCH, ØFDH, or ØFEH is returned by WRITE.

An error will be generated if a WRITE is specified for a drive other than RAM disk (A:) and FDD (D:, E:, F:, G:). Use MIOS subroutines for MCT.

Entry Name	LISTST	Entry Address	WBOOT + 2AH
Function	Returns the status of the list device.		
Entry parameter	None.		
Return parameter	A = FFH: Ready (sending data on the list device is allowed). A = 00H: Busy (sending data on the list device is disallowed).		

Explanation

LISTST checks the LST: field (bits 7 and 6) of the I/O byte and returns the status of the corresponding device.

I/O byte

Bit 7	Bit 6	
0	0	(TTY): Checks the serial port. 0FFH: Control In is high. 00H: Control In is low.
0	1	(CRT): Returns FFH because the device is always set to LCD.
1	0	(LPT): Checks the RS-232C interface.

			ØFFH: DSR is high.
			ØØH: DSR is low.
1	1	(UL1):	Always returns ØFFH if no actual device is defined.

Entry Name	SECTRN	Entry Address	WBOOT + 2DH
Function	Translates a logical sector to a physical sector.		
Entry parameter	BC = Logical sector number.		
Return parameter	HL = Physical sector number.		
Explanation			

Actually, SECTRN performs no actual translation but returns the physical sector number identical to the logical sector number. This function is originally provided to perform skew processing to increase FD performance. Therefore, physical to logical sector translation is not necessary for drives other than FDD.
For FDD, SECTRN need not translate sector numbers because the FDD connected to MAPLE is intelligent to perform logical to physical sector translation.

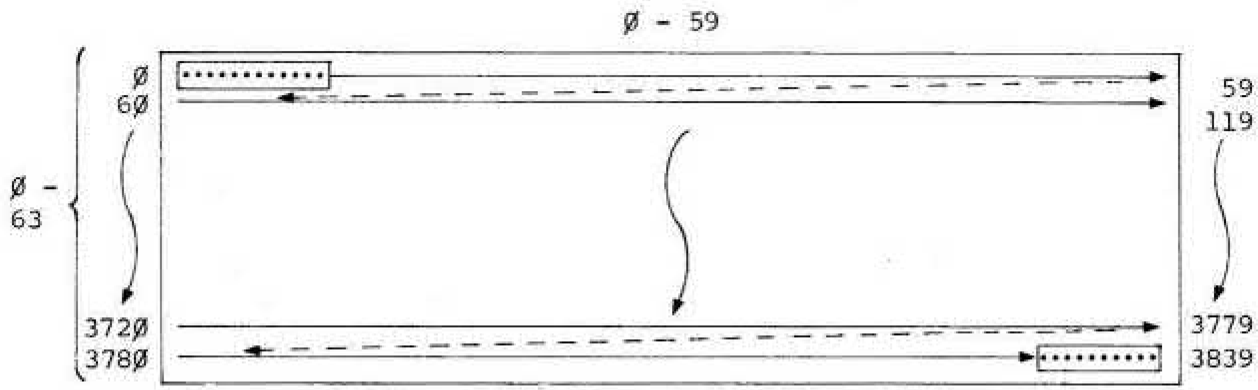
Entry Name	PSET	Entry Address	WBOOT + 30H
Function	Converts graphics screen data for display.		
Entry parameter	B = Data to be converted. C = Function. 01H: AND, 02H: OR, 03H: XOR In other cases, PSET loads the C reg. with the data at the address specified by HL. HL = Graphics screen address of the data to be converted. (0 - 3839)		
Return parameter	A = 00H: Normal termination. = FFH: Screen is in character mode. = Others: HL contains an address other than graphics screen addresses (0 - 3839). C = Loaded with the operation result upon normal termination.		
Explanation			

PSET processes the 1 byte data at the address specified by HL and data in the B reg. on the graphics screen according to the data in the C reg., then places the result to the C reg. An error is reported in the following conditions:

- When the screen is not in graphics mode.
- When HL is loaded with an address other than the graphics screen addresses (0 - 3839).

PSET only loads the C reg. with the data at the specified address on the graphics screen when the C reg. contains other than 01H, 02H, and 03H.

Each byte on the graphics screen is assigned an address as shown below:



Entry Name	SCRNDUMP	Entry Address	WBOOT + 33H
Function	Takes a hard copy of the displayed data.		
Entry parameter	None.		
Return parameter	LSTERR (F69EH) = ØØH: Normal termination. = ØFFH: Terminated with CTRL/STOP key.		
Explanation			

SCRNDUMP checks the I/O byte and dumps (outputs) the current data on the LCD screen onto the device (serial, RS-232C) specified in the LST: field. However, it does nothing if the LST: field is set to CRT (LCD).

The dump operation can be terminated any number of times by pressing the CTRL/STOP key. LSTERR indicates whether the operation was terminated with the CTRL/STOP key.

SCRNDUMP sends the display data to the serial port or RS-232C interface as characters when character mode is selected. It checks the sixth DIP switch and converts special codes to spaces before output.

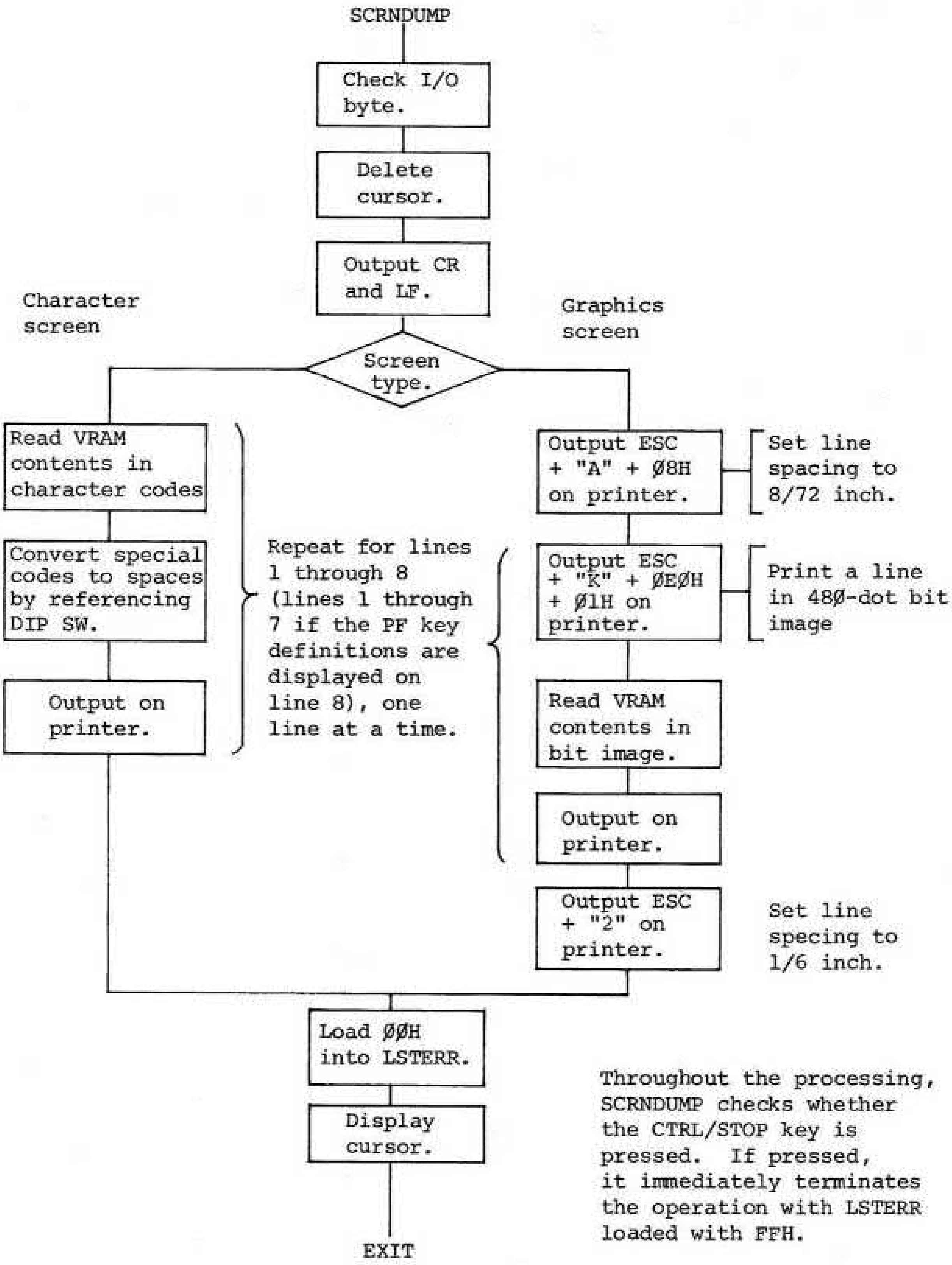
Sixth DIP switch

0: Converts 00H - 1FH, 7FH, and 0FFH to spaces.

1: Converts 00H - 1FH and 7FH - 0FFH to spaces.

The display data is output to the serial port or RS-232C interface in bit image when graphics mode is selected.

In either mode, seven lines from the top are output on the printer if the PF key definitions are displayed on line 8.


SCRNDUMP
Check I/O byte.
Delete cursor.
Output CR and LF.
Character screen
Graphics screen
Screen type.
Read VRAM contents in character codes
Convert special codes to spaces by referencing DIP SW.
Output on printer.
Repeat for lines 1 through 8 (lines 1 through 7 if the PF key definitions are displayed on line 8), one line at a time.
Output ESC + "A" + Ø8H on printer.
Set line spacing to 8/72 inch.
Output ESC + "K" + ØEØH + Ø1H on printer.
Print a line in 48Ø-dot bit image
Read VRAM contents in bit image.
Output on printer.
Output ESC + "2" on printer.
Set line specing to 1/6 inch.
Load ØØH into LSTERR.
Display cursor.
EXIT
Throughout the processing, SCRNDUMP checks whether the CTRL/STOP key is pressed. If pressed, it immediately terminates the operation with LSTERR loaded with FFH.

Entry Name	BEEP	Entry Address	WBOOT + 36H
Function	Sounds the speaker.		
Entry parameter	C = Specifies the duration of a beep in 100 ms units. BEEP does nothing if C = 0. DE = Specifies the period in 3.2 us units. $\text{Frequency} = \frac{1}{3.2 \times (DE)} \times 106\ \text{Hz}$		
Return parameter	None.		
Explanation			

BEEP generates a beep sound in the period specified by DE with the duration of time specified by C.

The processing can be terminated any number of times by pressing the CTRL/STOP key or turning the power switch off.

BEEP can be used as a 100 ms software timer because it waits for the length of time specified by the C reg. without generating sound if DE = 0000H.

Entry Name	RSOPEN	Entry Address	WBOOT + 39H
Function	Opens the RS-232C interface.		
Entry parameter	None.		
Return parameter	A = 00H: Normal termination. = 02H: Already open. = 04H: An invalid specification was found in the conditions set by CONFIG for RS-232C. This error causes no problem as long as CONFIG specifies the conditions for RS-232C but may cause a problem if the work area has been updated directly by the application program.		
Explanation			

RSOPEN initializes the RS-232C interface based on the conditions set by CONFIG, turns RS-232C power on, enables RS-232C receive interrupts (8251 interrupts) for RS-232C communication.

RSOPEN must be executed before executing the following routines:

RSIN

RSINST

RSOUTST

RSOUT

Entry Name	RSCLOSE	Entry Address	WBOOT + 3CH
Function	Closes the RS-232C interface.		
Entry parameter	None.		
Return parameter	None.		
Explanation			

RSCLOSE turns RS-232C power off and disables RS-232C receive interrupts.

Entry Name	RSINST	Entry Address	WBOOT + 3FH
Function	Informs whether the RS-232C interface has received data.		
Entry parameter	None.		
Return parameter	See below.		
Explanation			

The status at termination is as follows:

1) Z flag = 1: Normal termination.

A = FFH: Received data present.

A = ØØH: No received data present.

BC = Number of received data bytes in the buffer.

2) Z flag = ØØH: Abnormal termination.

A = Ø3H: RS-232C is not open.

Entry Name	RSOUTST	Entry Address	WBOOT + 42H
Function	Checks whether the RS-232C interface is ready for transmission.		
Entry parameter	None.		
Return parameter	A = ØØH: Transmission disabled. (Z flag = 1) = FFH: Transmission enabled. (Z flag = 1) = Ø3H: RS-232C is not open. (Z flag = Ø)		

Explanation

The RS-232C interface is enabled for transmission when the following two conditions are met:

1) 8251 TxRDY = 1.

(For Overseas Version 1.Ø, TxEMPTY must also be set to 1.)

2) No XOFF is received when XON/XOFF control is specified.

Entry Name	RSIN	Entry Address	WBOOT + 45H
Function	Receives one character from RS-232C.		
Entry parameter	None.		
Return parameter	Z flag = 1: Normal termination. A = Received data. Z flag = Ø: Abnormal termination. A = Ø3H: RS-232C is not open. A = Ø4H: CTRL/STOP key is pressed.		
Explanation			

When no data is present at the RS-232C interface, RSIN waits until data is received. Processing can be terminated by pressing CTRL/STOP key.

If XON/XOFF control is specified, RSIN sends an XON when the number of the received bytes in the buffer has reduced down to 1/4 of the buffer capacity after it sent an XOFF.
When SI/SO is specified, RSIN performs SI/SO processing on the received data.

As explained above, XON/XOFF and SI/SO codes are processed by the operating system and not returned to the application program as data bytes.

Entry Name	RSOUT	Entry Address	WBOOT + 48H
Function	Transfers one character to RS-232C.		
Entry parameter	None.		
Return parameter	Z flag = 1: Normal termination. Z flag = 0: Abnormal termination. A = 03H: RS-232C is not open. A = 04H: CTRL/STOP key was pressed.		
Explanation			

RSOUT checks whether the RS-232C interface is enabled for output (conditions are the same as with RSOUTST) and, if it is disabled, waits until the interface is ready for transmission. Processing can be terminated by pressing the CTRL/STOP key.

RSOUT sends an SI or SO code before sending the pertinent data byte if SI/SO control is specified.

Entry Name	TIMDAT	Entry Address	WBOOT + 4BH
Function	Performs clock and alarm functions.		
Entry parameter	Described below.		
Return parameter	Described below.		
Explanation			

TIMDAT provides the following six functions:

1. Reads the time. (C = 00H)
2. Sets the time. (C = 0FFH)
3. Enables the alarm/wake function. (C = 80H)
4. Disables the alarm/wake function. (C = 81H)
5. Sets the alarm/wake time. (C = 82H)
6. Reads the alarm/wake time. (C = 84H)

The calling program must call TIMDAT after loading the C reg. with the code of the function to be performed and the D reg. with the starting address of the packet (time descriptor) for transferring time-related data. TIMDAT will do nothing if the C reg. is loaded with a code other than the above codes.

TIMDAT assumes the following clock specifications:

- Maximum time count is 23:59:59 12/31/1999.
- Leap year processing is performed automatically.
- The time is represented in the 24-hour system.
- The day of the week is not set automatically but updated when the day changes.

Time descriptor structure

The time descriptor consists of 11 bytes as shown below. Not a: bytes are necessarily used by a function.

(DE)----→

①	Loaded with the lowest two digits of the year in BCD code.	1 byte
②	Loaded with the month in BCD code.	1 byte
③	Loaded with the day in BCD code.	1 byte
④	Loaded with the hour in BCD code.	1 byte
⑤	Loaded with the minute in BCD code.	1 byte
⑥	Loaded with the second in BCD code.	1 byte
⑦	Loaded with the day of the week.	1 byte
⑧	Loaded with the alarm/wake type.	1 byte
⑨	Loaded with the address.	2 bytes
⑩	Loaded with the status.	1 byte

(1) - (6): Year, month, day, hour, minute, second

The time data 1984, 09, 14, 15, 53, 28 is loaded as follows:

84H, Ø9H, 14H, 15H, 53H, 28H

(1) (2) (3) (4) (5) (6)

(7): Day of the week

ØØH, Ø1H, Ø2H, Ø3H, Ø4H, Ø5H, Ø6H

SUN. MON. TUE. WED. THU. FRI. SAT.

(8): Type

Specifies the alarm/wake type.

ØØH --- No specification.

Ø1H --- Sets the alarm.

(Displays an alarm message at the specified time.)

Ø2H --- Specifies wake1.

(Performs the function identified by the string at the address specified in (9) at the specified time.)

Ø3H --- Specifies wake2.

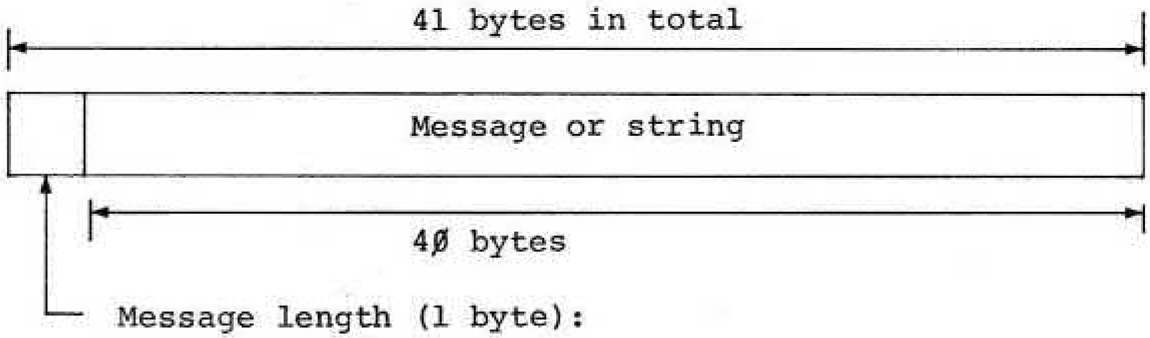
(Executes the subroutine at the address specified in (9) at the specified time.)

(9): Address

The meaning of the address differs depending on the type specified in (8).

Type	Meaning
01H -----	Starting address of the alarm message.
02H -----	Starting address of the string identifying the function to be executed during wakel.
03H -----	Starting address of the subroutine (processing) t be executed during wake2.

The alarm message and wakel string must be defined in the following format:



Specify the actual message text or string length in binary from ØØH to 28H. ØØH indicates no message or null string.

(10): Status

Identifies the alarm/wake interrupt type.

Interrupt type	Status value
Alarm/wake time is specified. ------- (via BIOS TIMDAT).	00H
Alarm/wake interrupt is generated. --	01H
Alarm/wake time is read ------------- (via BIOS TIMDAT).	Set to 00H after the current status is returned.

TIMDAT returns 01H only when it has read an alarm/wake time for the first time after an alarm/wake interrupt occurs. TIMDAT continues to return 00H whenever called until the next interrupt occurs.

Entry Name	TIMDAT (1)	Entry Address	WBOOT + 4BH
Function	Reads the time.		
Entry parameter	C = ØØH DE = Time descriptor starting address.		
Return parameter	DE = Time Descriptor starting address.		
Explanation			

TIMDAT (1) loads the time descriptor fields (1) to (7) with the year, month, day, hour, minute, second, and day of the week to set the clock.

Entry Name	TIMDAT (2)	Entry Address	WBOOT + 4BH
Function	Sets the time.		
Entry parameter	C = ØFFH DE = Time descriptor starting address.		
Return parameter	DE = Time descriptor starting address.		
Explanation			

TIMDAT (2) loads the time descriptor fields (1) to (7) with the year, month, day, hour, minute, second, and day of the week that are read from the clock. The BCD digits which are loaded with ØFH codes retain the previous time settings.

Since TIMDAT (2) makes no check, the validity of the subsequent information supplied by the clock is not guaranteed if logically invalid data is specified in this function.

Entry Name	TIMDAT (3)	Entry Address	WBOOT + 4BH
Function	Enables an alarm/wake function.		
Entry parameter	C = 8ØH		
Return parameter	None.		
Explanation			

No alarm/wake interrupt will be generated even when an alarm/wake time is specified until the alarm/wake function is enabled by TIMDAT (3).

Entry Name	TIMDAT (4)	Entry Address	WBOOT + 4BH
Function	Disables an alarm/wake function.		
Entry parameter	C = 81H		
Return parameter	None.		

Explanation

No alarm/wake interrupt occurs once TIMDAT (4) is executed.

To use the alarm/wake function again, it is necessary to redefine alarm/wake time using the following steps:

1) Specify the alarm/wake time.

2) Enable the alarm/wake time.

Entry Name	TIMDAT (5)	Entry Address	WBOOT + 4BH
Function	Specifies the alarm/wake time.		
Entry parameter	C = 82H DE = Time descriptor starting address.		
Return parameter	DE = Time descriptor starting address.		
Explanation			

Call TIMDAT (5) after filling the month to address fields (entries (2) - (9)) in the time descriptor .

The year cannot be specified for the alarm/wake function. The value in the unit place in the second field (the lowest 4 bits of (6)) is also ignored because TIMDAT (5) monitors only the value in the ten's place.

Any BCD digits which are set to ØFH (four bits are all set to 1) in the entries from the month to the day of the week are regarded as matching any time value. For example, alarm/wake will be invoked at the specified time every day if the month and day are set to ØFFH.

Since TIMDAT (5) makes no entry data check, normal clock operation cannot be guaranteed if invalid data is specified. No alarm/wake interrupt will be generated even when an alarm/wake time is specified until the alarm/wake function is enabled by TIMDAT (5).

Entry Name	TIMDAT (6)	Entry Address	WBOOT + 4BH
Function	Reads the alarm/wake time.		
Entry parameter	C = 84H DE = Time descriptor starting address.		
Return parameter	DE = Time descriptor starting address.		
Explanation			

The current alarm/wake settings are loaded into the year to status fields of the time descriptor ((1) - (10)) after TIMDAT (6) is executed. The year field and the first digit of the second field are always set to 0FFH and 0FH, respectively. This is because they are never set by TIMDAT (5).

The validity of the data loaded into the time descriptor is not guaranteed if TIMDAT (6) is executed with no alarm/wake information specified.

Entry Name	MEMORY	Entry Address	WBOOT + 4EH
Function	Does nothing.		
Entry parameter	None.		
Return parameter	None.		
Explanation			

Entry Name	RSIOX	Entry Address	WBOOT + 51H
Function	Performs various RS-232C functions.		
Entry parameter	Described below.		
Return parameter	Described below.		
Explanation			

RSIOX provides the following ten functions which are identified by the contents of the B reg.:

1. Opens RS-232C. (B = 1ØH)
2. Closes RS-232C. (B = 2ØH)
3. Informs whether RS-232C has received data. (B = 3ØH)
4. Checks whether RS-232C is enabled for transmission. (B = 4ØH)
5. Receives one character from RS-232C. (B = 5ØH)
6. Sends one character from RS-232C. (B = 6ØH)
7. Checks the control line status. (B = 7ØH)
8. Sets the control line. (B = 8Ø)
9. Checks the error status. (B = 9ØH)
1Ø. Checks whether RS-232C is open. (B = ØFØH)

Entry Name	RSIOX (OPEN)	Entry Address	WBOOT + 51H
Function	Opens the RS-232C interface.		
Entry parameter	B = 10H HL = Parameter block starting address.		
Return parameter	A = 00: Normal termination. (Z flag = 1) = 02H: Already open. (Z flag = 0) = 03H: Invalid parameter. (Z flag = 0) HL = Parameter block starting address. (The parameter block is loaded with status data.)		
Explanation			

RSIOX (OPEN) initializes the RS-232C interface based on the conditions set in the specified parameter block, turns RS-232C power on, enables the RS-232C controller (8251) for receive interrupts) to ready the interface for communication.

RSIOX (OPEN) has the same functions as RSOPEN (WBOOT + 39H) except that it allows the user to initialize the RS-232C interface.

The calling program must always call RSIOX before performing I/O operations to or from the RS-232C interface.

Parameter block structure

(HL) ------>

1	Receive Buffer Starting Address	2 bytes
2	Receive Buffer Length	2 bytes
3	Baud Rate	1 byte
4	Bits/Char	1 byte
5	Parity	1 byte
6	Stop Bits	1 byte
7	Special Parameter	1 byte

(1) Receive Buffer Starting Address

Specifies the starting address of the receive buffer. The buffer may be located anywhere in the CP/M TPA.

(2) Receive Buffer Length

Specifies the length of the receive buffer.

(3) Bit Rate

Specifies the bit rate. The table below lists the codes that correspond to the available bit rates.

Code	Bit Rate (BPS)
ØFH	192ØØ
ØEH	96ØØ
ØDH	48ØØ
ØCH	24ØØ
ØAH	12ØØ
Ø8H	6ØØ
Ø6H	3ØØ
Ø5H	2ØØ ← Not supported in the overseas versions.
Ø4H	15Ø
Ø2H	11Ø
81H	75/12ØØ (Tx/Rx)
8ØH	12ØØ/75 (Tx/Rx)

→ Tx and Rx represent the transmit and receive bit rates, respectively. Tx and Rx may be different.

(4) Bit/Char

Specifies the character length in bits.

ØØ2H --- 7 bits/character

Ø3H --- 8 bits/character

(5) Parity

Specifies parity check type.

ØØH --- No parity

Ø1H --- Odd

Ø3H --- Even

(6) Stop Bits

Specifies the number of stop bits.

Ø1H --- 1 bit

Ø3H --- 2 bits

(7) Special Parameter

Specifies the RS-232C operating modes and status on a bit basis.

Bit	Description
Ø	Controls the DTR line. Ø: OFF (-8V) 1: ON (+8V)
1	Controls the RTS line. Ø: OFF (-8V) 1: ON (+8V)
2	Specifies whether SI/SO is to be controlled. Ø: Controlled. (Valid only for 7 bits/char. data width) 1: Not controlled.
3	Not used.
4	Specifies whether XON/XOFF control is to be used. Ø: Controlled. 1: Not controlled.
5 - 7	Not used.

This byte must be set to ØFFH when not used.

Parameter block contents on return

On return, the HL reg. retains the starting address of the parameter block that was specified on entry. The contents of the parameter block are changed as follows:

(HL) --->

1	Status	1 byte
2	GET Point	2 bytes
3	PUT Point	2 bytes
4	Receive Buffer Starting Address	2 bytes
5	Receive Buffer Length	2 bytes

(1) Status

Indicates the RS-232C status.

Bit	Description
Ø	Indicates whether RS-232C is open. Ø: Open. 1: Not open.
1	Indicates whether the receive buffer is full. Ø: Not full. 1: Full.
2	Indicates whether a receive buffer overflow occurred. Ø: No overflow occurred. 1: Overflow occurred. Some data must have been discarded.
3	Indicates the CD line status (inverted). Ø: CD line is high. (+3 ~ +15V) 1: CD line is low. (-3 ~ -15V)
4	Indicates whether a parity error occurred. Ø: No parity error occurred. 1: Parity error occurred.
5	Indicates whether an overrun error occurred in 8251 during data reception. Ø: No overrun error occurred. 1: Overrun error occurred.

	Overrun errors are likely to occur when data transfer is too fast.
6	Indicates whether a framing error occurred during data reception. Ø: No framing error occurred. 1: Framing error occurred. Framing errors occur when the parameters of the RS-232C (bit rate, bits/char, parity, stop bits) do not match those of the counterpart terminal.
7	Indicates the DSR line status. Ø: DSR line is high. (+3 ~ +15V) 1: DSR line is low. (-3 ~ -15V)

Bits Ø, 1, 3, and 7 always indicate the current status. Bits 2, 4, 5, and 6, on the other hand, retains the error status until the RSIOX error check function is executed once an error occurred.

(2) GET Point

The address of the next data to be taken from the receive buffer.

(3) PUT point

The receive buffer address into which the next data received by 8251 is to be placed.

(4) Receive Buffer Starting Address

The address specified on entry.

(5) Receive Buffer Length

The length specified on entry.

Entry Name	RSIOX (CLOSE)	Entry Address	WBOOT + 51H
Function	Closes the RS-232C interface.		
Entry parameter	B = 20H		
Return parameter	None.		
Explanation			

RSIOX (CLOSE) turns RS-232C power off and disables RS-232C receive interrupts. The functions of RSIOX (CLOSE) is identical to those of RSCLOSE (WBOOT + 3CH).

Entry Name	RSIOX (INSTS)	Entry Address	WBOOT + 51H
Function	Indicates whether there is any data in the receive buffer.		
Entry parameter	B = 30H HL = Starting address of the field for storing 9-byte return information.		
Return parameter	Described below.		

Explanation

The status information that RSIOX (INSTS) returns on termination is as follows:

(1) Z flag = 1: Normal termination.

A = 0FFH: Data has been received.

= 00H: No data in the receive buffer.

BC = Number of bytes of received data in the buffer.

HL = Address specified on entry. The nine bytes starting at this address contains the return information described earlier (see RSIOX (OPEN)).

(2) Z flag = 0: Abnormal termination.

A = 03H: RS-232C is not open.

HL retains the previous value.

Entry Name	RSIOX (OUTST)	Entry Address	WBOOT + 51H
Function	Checks whether RS-232C is enabled for transmission.		
Entry parameter	B = 4ØH HL = Starting address of the field for storing 9-byte return information.		
Return parameter	Described below.		
Explanation			

The status information RSIOX (OUTST) returns on termination is as follows:

(1) Z flag = 1: Normal termination.

A = ØØH: Transmission disabled.

= ØFFH: Transmission enabled.

HL = The address specified on entry. The nine bytes starting at this address contains the return information described earlier (see RSIOX (OPEN)).

The RS-232C interface is enabled for transmission when the following two conditions are satisfied:

1) 8251 TxRDY = 1

(For Overseas Version 1.0, TxEMPTY must also be set to 1.)

2) No XOFF is received when XON/XOFF control is specified.

(2) Z flag = 0: Abnormal termination.

A = 03H: RS-232C is not open.

HL retains the previous value.

Entry Name	RSIOX (GET)	Entry Address	WBOOT + 51H
Function	Receives one character from the RS-232C interface.		
Entry parameter	B = 5ØH HL = Starting address of the field for storing 9-byte return information.		
Return parameter	Described below.		
Explanation			

RSIOX (GET) returns the following status on termination:

(1) Z flag = 1: Normal termination.

A = Received data.

HL = The address specified on entry. The nine bytes starting at this address contains the return information described earlier (see RSIOX (OPEN)).

(2) Z flag = Ø: Abnormal termination.

A = Ø3H: RS-232C is not open.

= Ø4H: CTRL/STOP key is pressed.

HL retains the previous value.

The actual function of RSIOX (GET) is identical to that of RSIN (WBOOT + 45H).

Entry Name	RSIOX (PUT)	Entry Address	WBOOT + 51H
Function	Transfers one character to the RS-232C interface.		
Entry parameter	B = 6ØH C = Send data HL = Starting address of the field for storing 9-byte return information.		
Return parameter	Described below.		
Explanation			

RSIOX (PUT) returns the following status on termination:

(1) Z flag = 1: Normal termination.

HL = The address specified on entry. The nine bytes starting at this address contains the return information described earlier (see RSIOX (OPEN)).

(2) Z flag = Ø: Abnormal termination.

A = Ø3H: RS-232C is not open.

= Ø4H: CTRL/STOP key is pressed.

HL retains the previous value.

The actual functions of RSIOX (PUT) is identical to those of RSOUT (WBOOT + 48H).

Entry Name	RSIOX (CTLIN)	Entry Address	WBOOT + 51H
Function	Reads the control line status.		
Entry parameter	B = 7ØH		
Return parameter	Described below.		

Explanation

RXIOX (CTLIN) returns the DSR and CD status when the RS-232C is open.

(1) Z flag = 1: Normal termination

A reg. Bit 7 = DSR status.

0: +3V to +8V

1: Lower than +3V

Bit 3 = CD status.

0: Lower than +3V

1: +3V to +8V

All bits other than bits 7 and 3 are set to 0.

(2) Z flag = 0: Abnormal termination

A = 03H: RS-232C is not open.

Entry Name	RSIOX (SETCTL)	Entry Address	WBOOT + 51H
Function	Sets control lines.		
Entry parameter	B = 8ØH C = Data set (see below).		
Return parameter	Z flag = 1: Normal termination. Z flag = Ø: Abnormal termination. A = Ø3H: RS-232C is not open.		
Explanation			

RSIOX (SETCTL) sets the DTR and/or RTS line states according to the contents of the C reg.

C reg. Bit Ø: Sets the DTR state.

= Ø: DTR set to - 8V (Low)

= 1: DTR set to + 8V (High)

Bit 1: Sets the RTS state.

= Ø: RTS set to - 8V (Low)

= 1: RTS set to + 8V (High)

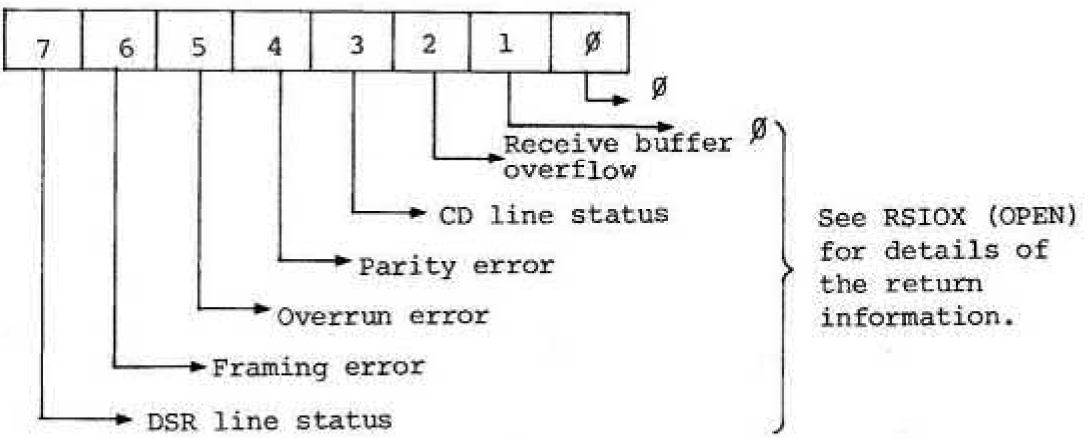
Bits 2 - 7: Not used.

Entry Name	RSIOX (ERSTS)	Entry Address	WBOOT + 51H
Function	Checks the RS-232C error status.		
Entry parameter	B = 90H		
Return parameter	Described below.		
Explanation			

RSIOX (ERSTS) returns the error status of the RS-232C interface when it is open. All errors are cleared on termination of RSIOX (ERSTS).

(1) Z flag = 1: Normal termination.

A = Error status



(2) Z flag = 0: Abnormal termination.

A = 03H: RS-232C is not open.

Entry Name	RSIOX (SENS)	Entry Address	WBOOT + 51H
Function	Checks whether the RS-232C interface is open.		
Entry parameter	B = ØFØH		
Return parameter	Z flag = 1: RS-232C is not open. A = ØØH Z flag = Ø: RS-232C is open. A = Ø2H		
Explanation			

Entry Name	LIGHTPEN	Entry Address	WBOOT + 54H
Function	Does nothing.		
Entry parameter	None.		
Return parameter	None.		
Explanation			

Entry Name	MASKI	Entry Address	WBOOT + 57H
Function	Sets or resets interrupt mask.		
Entry parameter	Described below.		
Return parameter	Described below.		
Explanation			

MASKI enables or disables the six interrupts supported by MAPLE.

(1) Entry parameters

B = Function

= Ø: Inhibits interrupts from the devices whose corresponding bit in the C reg. is 1.

= 1: Enables interrupts from the devices whose corresponding bit in the C reg. is 1.

≧ 2: Checks the current enabled or disabled status.

C = Specifies which type of interrupts are to be processed according to the contents in the B reg.

Bit Ø: 75Ø8 interrupts

Bit 1: RS-232C (8251) receive interrupts

Bit 2: RS-232C Carrier Detect interrupts

Bit 3: FRC overflow interrupts

Bit 4: Bar code reader interrupts

Bit 5: External interrupts

Bit 6: Not used.

Bit 7: Not used.

The Interrupts for which the corresponding bits are set to 1 are processed according to the specification in the B reg. The interrupts for which the corresponding bit is set to Ø retain their previous state. Bits 6 and 7 must be set to Ø.

(2) Return parameter

A = Loaded with return information indicating whether the individual interrupts are enabled after this function is executed. The correspondence between the bits and interrupt types is the same as that shown above. Interrupts are enabled if the corresponding bit is set to 1 and disabled if it is set to Ø.

See Chapter 1Ø for details on individual interrupts.

Entry Name	LOADX	Entry Address	WBOOT + 5AH
Function	Reads one byte of data from the specified bank.		
Entry parameter	C = Bank from which data is to be read. ØØH = User bank ØFFH = System bank HL = Address of the data to be read.		
Return parameter	A = Data Other registers retain the previous values.		
Explanation			

LOADX is used in application programs to read the contents of OS ROM. The user bank is selected when a value other than ØØH and ØFFH is specified in the C reg.

Entry Name	STORX	Entry Address	WBOOT + 5DH
Function	Writes one byte of data to the specified bank.		
Entry parameter	A = Data to be written. C = Bank to which data is to be written. ØØH = User bank ØFFH = System bank HL = Address at which data is to be written.		
Return parameter	All registers retain the previous values.		
Explanation			

STORX is not used in application programs. Nothing will happen if it is used to write data into the system bank ROM.

The user bank is selected when a value other than ØØH and ØFFH is specified in the C reg.

Entry Name	LDIRX	Entry Address	WBOOT + 60H
Function	Transfers the data on the specified bank onto another bank.		
Entry parameter	A = 00H: Transfers data from the system to user bank. = 0FFH: Transfers data from the user to system bank. HL = Starting address of the data to be transferred. DE = Starting address of the destination to which data is to be transferred. BC = Number of bytes of data to be transferred.		
Return parameter	A = 00H BC = 0000H DE = DE + BC HL = HL + BC } Register contents on termination.		
Explanation			

LDIRX is used in application programs to transfer the contents of OS ROM to RAM. Specifying a value other than 00H and 0FFH in the A reg. causes the same effect as specifying 00H.

Entry Name	JUMPX	Entry Address	WBOOT + 63H
Function	Jumps to the specified bank address.		
Entry parameter	(DISBNK) = ØØH: Jumps to the specified address on the user bank. = ØFFH: Jumps to the specified address on the system bank. IX = Destination of jump.		
Return parameter	None.		
Explanation			

JUMPX causes program execution to jump to an address in OS ROM. JUMPX is rarely used in application programs.

This BIOS call is also terminated when a RET statement is encountered in the routine at the jump address. Since control branches with the stack in the BIOS, an error may occur if the stack level goes too deep during the execution of the called routine.

The DISBNK address is:

0F539H --- for Overseas Version OS

0F2B6H --- for Japanese Version OS

Specifying a value other than 00H and 0FFH in DISBNK has the same effect as specifying 00H.

Entry Name	CALLX	Entry Address	WBOOT + 66H
Function	Calls the specified bank address.		
Entry parameter	(DISBNK) = ØØH: Calls the specified address on the user bank. = ØFFH: Calls the specified address on the system bank. IX = Called routine address		
Return parameter	None.		
Explanation			

CALLX is used by application programs to directly call a routine in OS ROM.

Since the routine is called with the stack for BIOS still, unexpected results may occur if the called subroutine uses too large an amount of stack area.

The DISBNK address is:

0F539H --- For Overseas Version OS

0F2B6H --- For Japanese Version OS

Specifying a code other than ØØH and ØFFH in DISBNK has the same effect as specifying ØØH.

Entry Name	GETPFK	Entry Address	WBOOT + 69H
Function	Reads in PF key data.		
Entry parameter	C = PF key number - 1 PF1 = 00H --- PF10 = 09H HL = Starting address of the character string to be read.		
Return parameter	HL = Retains the previous value.		
Explanation			

GETPFK gets a character string defined for a PF key in 16-byte format as shown below. GETPFK does nothing when a value other than 00H to 09H is specified in the C reg.

(HL)

Number of characters	Character 1	Character 2	Character 3	Character 4	---------	Character 14	Charact 15

15 bytes

ØØH - ØFH:

Indicates the number of characters in the string. ØØH indicates that no string is defined for this PF key.

Example

Ø3H	"P"	"I"	"P"				-----------		

→ The contents of the subsequent bytes are not guaranteed.

Entry Name	PUTPFK	Entry Address	WBOOT + 6CH
Function	Defines a PF key.		
Entry parameter	C = PF key number - 1 PF1 = ØØH --- PF1Ø = Ø9H HL = Starting address of the character string to be assigned.		
Return parameter	HL = Retains the previous value.		

Explanation

PUTPFK assigns a character string to a PF key in the 16-byte format. The maximum string length is 15 characters. PUTPFK does nothing when a value other than ØØH to Ø9H is specified in the C reg.

(HL)

Number of characters	Character 1	Character 2	Character 3	Character 4	Character 5	-----	Character 14	Character 15

ØØH - ØFH: ← 15 bytes (Character 1 – Character 15) →

Specifies the number of defined characters in binary. ØØH indicates that no string is defined for the specified PF key.

If old PF key definitions are displayed on the screen, they are also updated as they are redefined by PUTPFK.

Entry Name	ADCVRT	Entry Address	WBOOT + 6FH
Function	Performs an analog data input operation.		
Entry parameter	C = Analog data to be selected.		
Return parameter	A = AD conversion results		
Explanation			

ADCVRT converts analog data selected by the parameter in the C reg. to digital data and returns the results to the A reg.

C = 00H: A/D channel 1 --- Data from the analog jack.

C = 01H: A/D channel 2 --- Data from the bar code reader connector.

C = 02H: DIP SW settings.

C = 03H: Battery voltage.

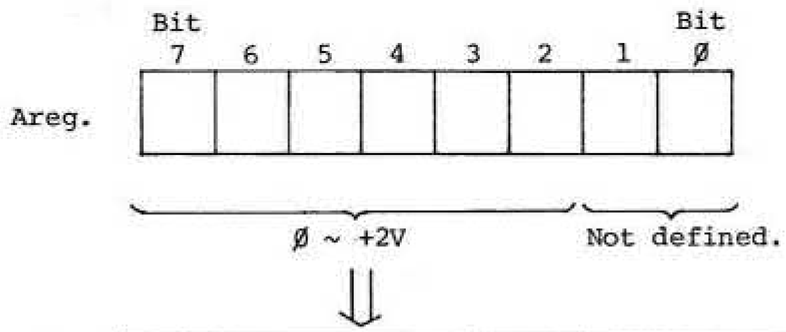
C = 04H: Main switch (for Power ON/OFF) and analog input connector trigger terminal settings.

ADCVRT does nothing when the C reg is loaded with a value other than 00H to 04H.

The pages that follow describe what data is returned to the A reg. according to the value specified in the C reg.

(1) When the C reg. = 00H or 01H

A voltage 0 to +2V applied to the A/D jack is converted to a digital quantity and placed into the highest 6 bits of the A reg. (resolution of 6 bits).



Each bit corresponds to $2V \div 2^6 \fallingdotseq 32mV$. These bits are all set to 1 when a voltage higher than +2V is input. They are set to Ø when a negative voltage is input.

(2) When the C reg. = 02H

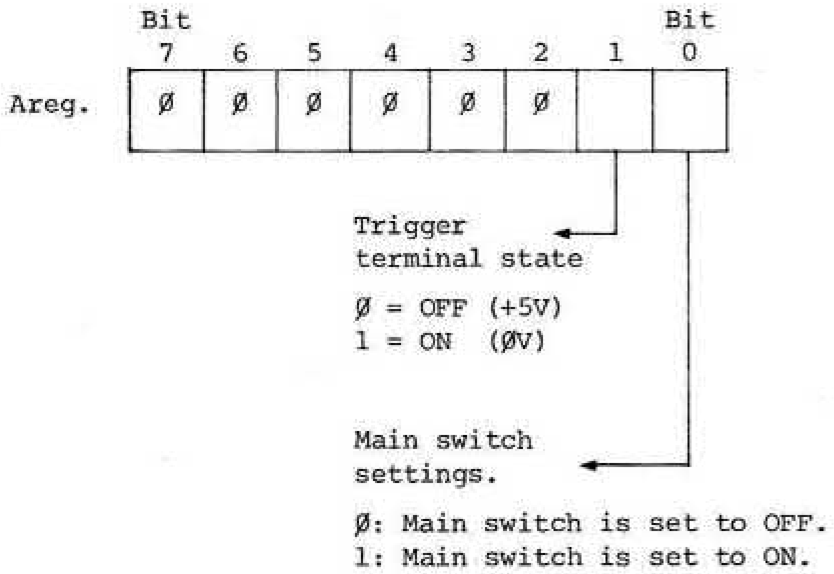
The settings for the DIP switches on the main unit back panel are placed into the A reg. in the following format:

(3) When the C reg. = 03H

The data about the battery voltage is placed in the A reg. See Chapter 11 for the correspondence between the battery voltages and the A reg. values.

(4) When the C reg. = 04H

The main switch settings and the analog input connector trigger terminal state are placed into the A reg.



MAPLE may be started even when the main switch is in the off position (by the wake function).

Entry Name	SLAVE	Entry Address	WBOOT + 72H
Function	Controls the communication with the SLAVE CPU.		
Entry parameter	DE = Communication packet starting address.		
Return parameter	A = 00H: Normal termination. ≠ 00H: Abnormal termination. DE = Retains the previous value.		
Explanation			

SLAVE is used by the application program to control the SLAVE CPU directly. See Chapter 13 for details on the functions that SLAVE can perform and the command and data used by SLAVE.

The SLVFLG field in the work area must be set as follows before this BIOS function is called:

The SLVFLG address is:

0F358H --- For Overseas Version OS

0F080H --- For Japanese Version OS

Bit 7: Always set to ON.

Bit 6: Set to ON when accessing SLAVE memory (executing command 00H, 01H, or 02H). Otherwise, this bit is set OFF.

Bit 5: Set to ON when writing data into the SLAVE CPU privileged memory (addresses 80H - 0ADH). Otherwise, this bit is set to OFF.

SLAVE immediately terminates abnormally if the SLVFLG field is found to be set improperly. The calling program must clears the SLVFLG field to 00H after returning from this BIOS subroutine.

The communication packet has the following format:

(DE) →

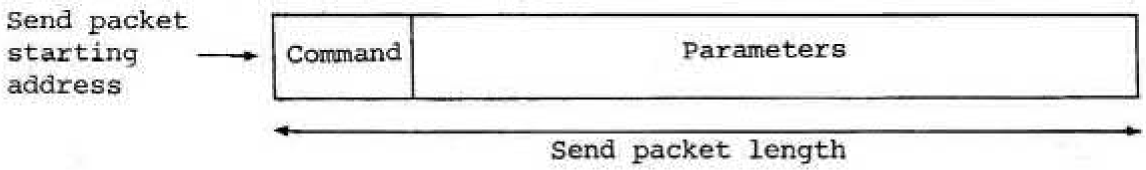
①	Send packet starting address	2 bytes
②	Send packet length	2 bytes
③	Receive packet starting address	2 bytes
④	Receive packet length	2 bytes

(1) Send packet starting address

(2) Send packet length

A send packet refers to a buffer area which contains a command or a command plus parameters to be passed to the slave CPU.

Send packet



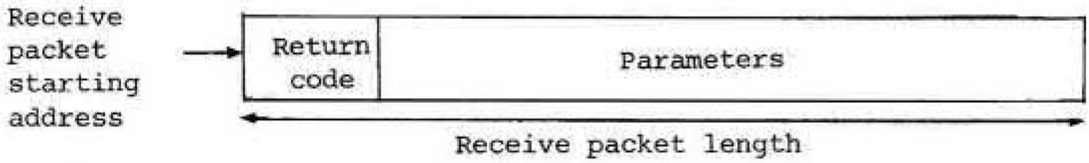
A send packet always begins with a 1-byte command, so the length of a send packet is normally longer 1 byte. When the length is Ø, SLAVE does nothing for send requests and performs only receive processing.

(3) Receive packet starting address

(4) Receive packet length

A receive packet is an area for storing the return code and parameters, if any, which the slave CPU returns after processing the command and the parameters passed from the SLAVE CPU in the above format.

Receive packet

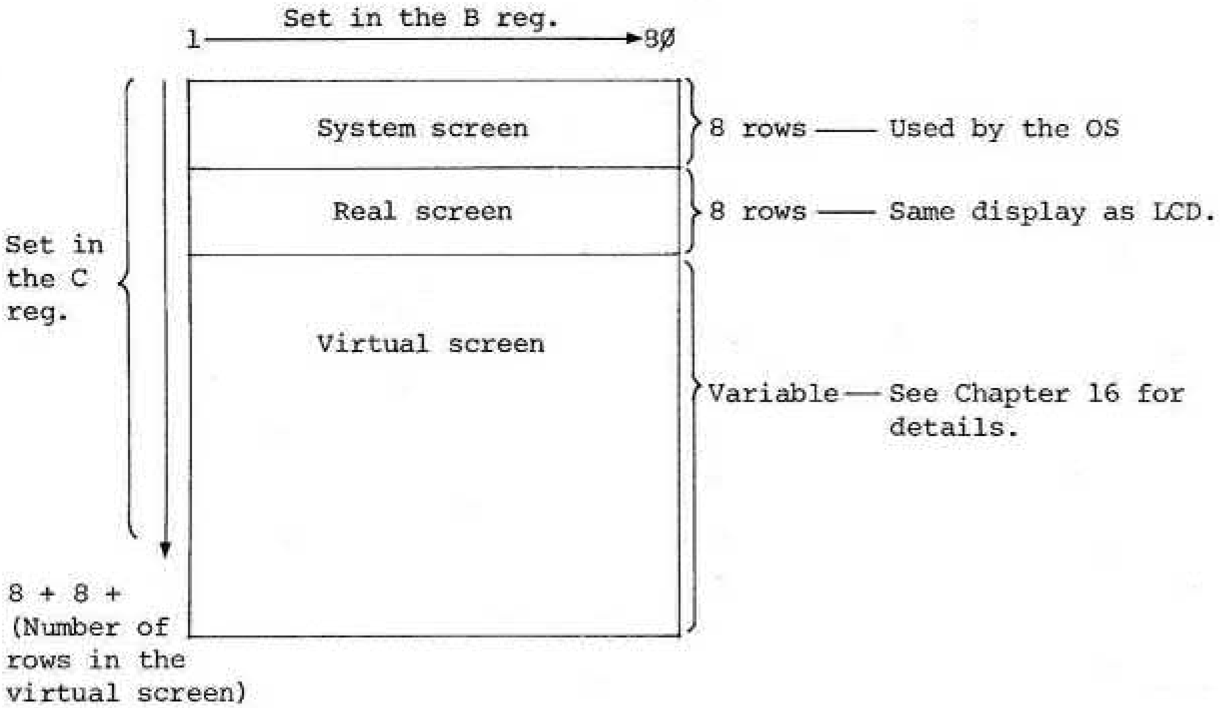


The return code and the contents of the A reg. are the same when SLAVE terminates normally. Since a return code is always returned on normal termination, the receive packet length should longer than 1 byte. When the receive packet length is Ø, no data is received from the slave CPU.

The main program can do its own tasks while the slave CPU is processing a command from the main program. The calling program can receive the return code and parameters that the slave CPU returns in response to the previous command by first sending a command or parameter with a receive packet length of Ø specified, then, after performing its main task, issuing a command with a send packet length of Ø. During this operation, however, the main program cannot perform any operation which involves slave CPU processing (e.g., screen or MCT processing). (Attempting to do so would result in a SLAVE hang-up.)

Entry Name	RDVRAM	Entry Address	WBOOT + 75H
Function	Reads the contents of VRAM.		
Entry parameter	B = Starting column number in which read is to begin (1 -80) C = Starting row number in which read is to begin. (1 - Bottom of screen) DE = Number of characters to be read. HL = Address of the area for storing the read data.		
Return parameter	A = 00H: Normal termination. = 01H: Display extends beyond the screen during a read. = FFH: Screen is in graphics mode. Or the starting position specified by B and C is outside the virtual screen. HL = Retains the previous value.		
Explanation			

RDVRAM reads the data on the character mode screen. The screen has the following structure:



RDVRAM reads the number of characters specified by DE starting at the position designated by B and C and stores them sequentially into the area starting at the address designated by DE. Characters are read from left to right in a row. After the 80th character is read, the leftmost character in the next row is read.

When the number specified in DE is too large and display extends beyond the screen, 00H codes are returned as extra characters until the number of the returned characters equals the value specified in DE. In this case, the A reg. is loaded with a return code of 01H.

Entry Name	MCMTX	Entry Address	WBOOT + 78H
Function	Processes MIOS communication.		
Entry parameter	B = MIOS function code (ØØH - 15H)		
Return parameter	Described below.		

Explanation

MCMTX is used to communicate with MIOS (entering commands or receiving data) to control MCT directly.

See Chapter 14 for details of MIOS functions.

Entry Name	POWEROFF	Entry Address	WBOOT + 7BH
Function	Turns main power off.		
Entry parameter	C = 00H: Main power turned off in continue mode. = 01H: Main power turned off in restart mode.		
Return parameter	None.		
Explanation			

POWEROFF is used in application programs to turn MAPLE main power off.

If power has been set off in continue mode, execution continues with the command following this BIOS call when power is turned on. The I/O settings established before the power-off is restored at the same time. This BIOS call must be followed by an EI instruction when power is turned off in continue mode.

If power has been set off in restart mode, execution will start at WBOOT when power is turned on.

See Chapter 9 for details of power-on/off.

Entry Name	USERBIOS	Entry Address	WBOOT + 7EH
Function	Provides the entry to USERBIOS.		
Entry parameter	None.		
Return parameter	None.		
Explanation			

USERBIOS provides an entry point through which the application program makes BIOS calls after loading its own BIOS routine in the RAM USERBIOS area. Presently, USERBIOS serves no purpose.

The following procedure must be observed when using a user-provided BIOS routine through the entry point at USERBIOS:

1) Load the BIOS routine into the RAM USERBIOS area.
2) Replace the contents of addresses (WBOOT + 7EH) + 1 and (WBOOT + 7EH) + 2 with the entry address bytes of the user routine in the USERBIOS area.
3) Call this BIOS in the application program.

See "USERBIOS Usage" for details.

Chapter 5 Keyboard

5.1 General

The MAPLE is furnished with a typewriter keyboard which contains special keys such as cursor movement keys (arrow keys) and programmable function keys. I/O operations concerning the keyboard is controlled by the 7508 sub-CPU. When a key entry is made, the 7508 informs the Z80 CPU of the presence of the key entry by generating an interrupt. The OS, on receipt of the interrupt, fetches information from the 7508 identifying the key location and takes the corresponding action. In addition to this key entry function, a number of MAPLE keyboard functions are supported at the OS level. Those keyboard functions are fully discussed in this chapter (see Chapter 11 for the 7508 CPU).

5.2 Keys and Keyboard Types

- Number of keys: 72 (73 keys for Japanese-language keyboard)
- Number of switch keys: 6

  * What is a switch key?

  When an ordinary key is pressed, the 7508 CPU provides only the information that indicates the depression of the key. When a switch key is pressed, however, it provides two types of information, that is the information indicating the depression of a key and the information indicating the release of the key. This kind of keys include SHIFT and CTRL are used to switch the keyboard mode. These keys are all controlled by the OS and application programs need not concern about this.

- Keyboard types

The MAPLE supports twelve types of keyboards to accommodate various languages. Keyboard and OS key entry routine assignments are defined by DIP-SW 1 through 4 in the MAPLE's ROM compartment. DIP-SW settings are shown on the ne page (see the end of this mannual for key assignments for different countries).

Keyboard type	DIP-SW 4	DIP-SW 3	DIP-SW 2	DIP-SW 1	Object OS
USASCII	1	1	1	1	ASCII OS
France	1	1	1	Ø	ASCII OS
Germany	1	1	Ø	1	ASCII OS
England	1	1	Ø	Ø	ASCII OS
Denmark	1	Ø	1	1	ASCII OS
Sweden	1	Ø	1	Ø	ASCII OS
Italy	1	Ø	Ø	1	ASCII OS
Spain	1	Ø	Ø	Ø	ASCII OS
Norway	Ø	1	1	Ø	ASCII OS
Kana	Ø	Ø	Ø	Ø	Japanese-language JIS OS
Japanese-language JIS keyboard	Ø	Ø	Ø	1	Japanese-language JIS OS
Japanese-language touch type keyboard	Ø	Ø	Ø	1	Japanese-language touch type OS

Ø --- OFF
1 --- ON

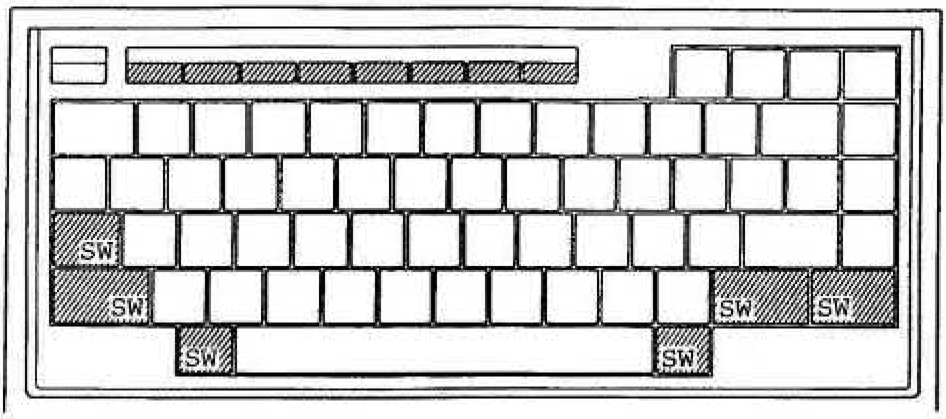
Auto repeat keys and switches

Auto repeat keys 

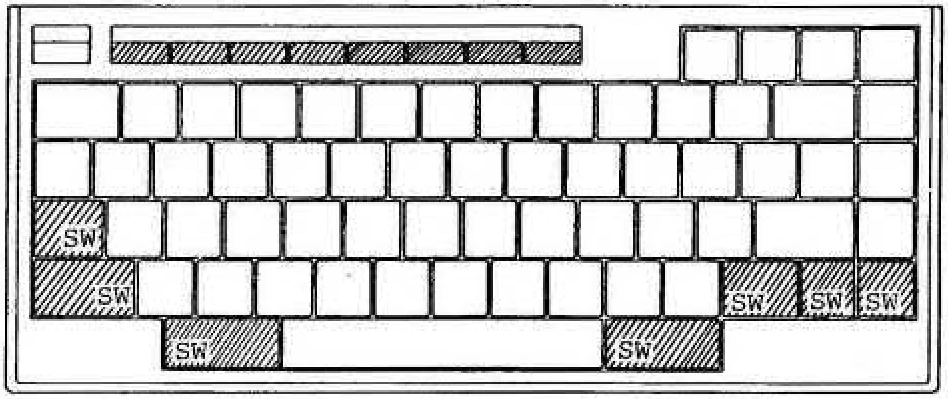
(Keys other than shaded keys)

Switch keys 

Keyboard other than Japanese-language keyboard



Auto repeat keys and switches



5.3 OS Key Routine Functions

- Keyboard buffers: 32 (The 7508 sub-CPU has 7 unique buffers own.)
- N-key rollover feature: Provided.
- Auto repeat feature: Provided. (See the previous page for auto repeat keys.)

  Repeat start time -- 656 ms

  Repeat period ---- 70 ms
- Auto repeat setting:

  Auto repeat ON/OFF state, repeat start time, and repeat period can be changed using the BIOS CONOUT routine.
- The CAPS, NUM, and GRAPH keyboard modes are indicated by LEDs on the keyboard.

5.4 Operation Flow

The steps below show the sequence of operations from key depression to transfer of the key data to the application program.

(1) A key is pressed.

(2) The 7508 scans the keyboard every 30 ms and, if a key entry is sensed, loads the corresponding hardware code into its own buffer.

(3) The 7508 reports the Z80 of a key entry via the interrupt line.

(4)(5)(6) The Z80 takes data from the 7508 buffer via the 7508 port and stores the data into the keyboard buffer. Any data overflowing the keyboard buffer is discarded.

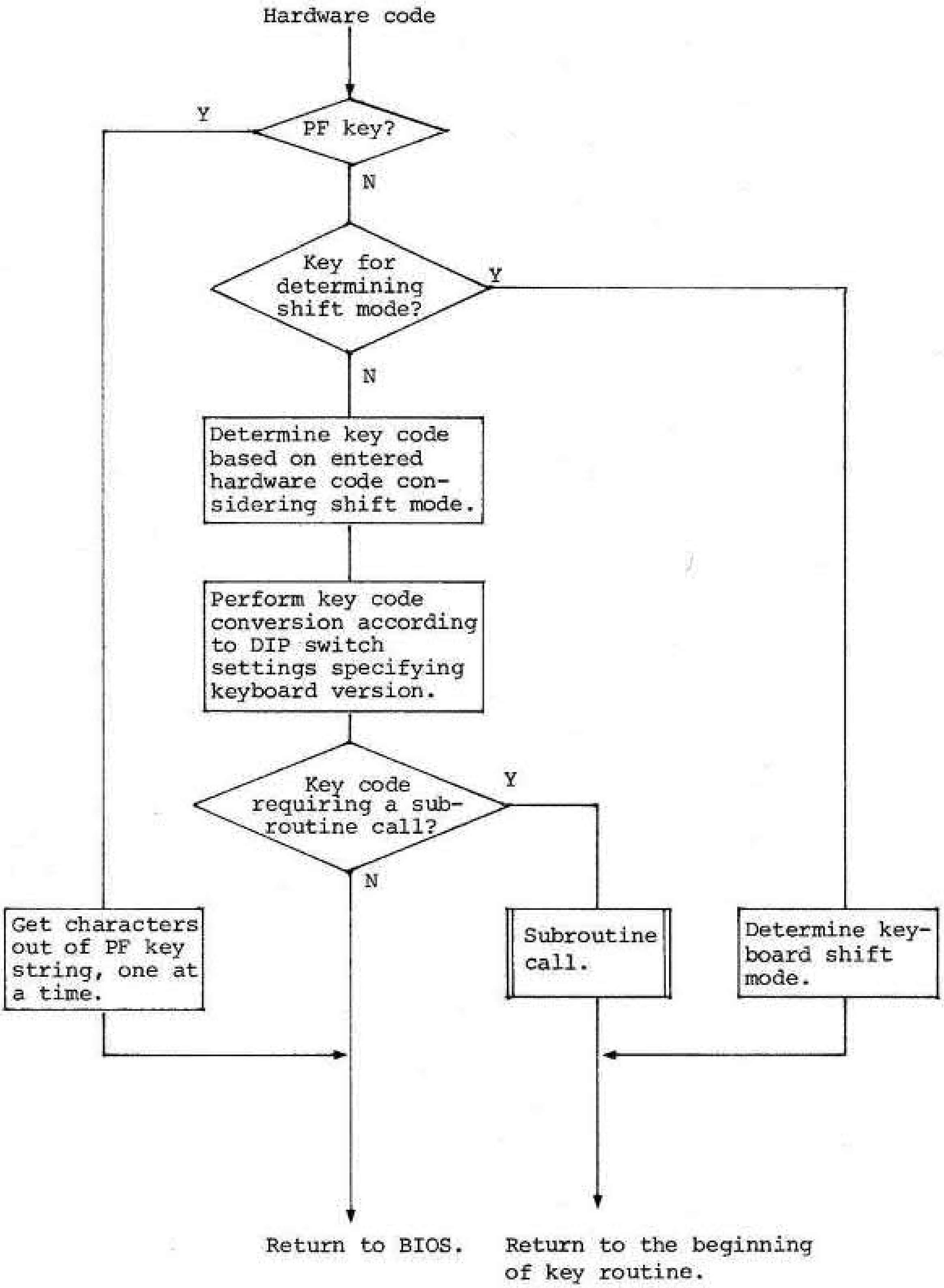
(7) The key routine takes hardware codes out of the keyboard buffer, one at a time, and returns the corresponding key codes to the application program after making the following checks:

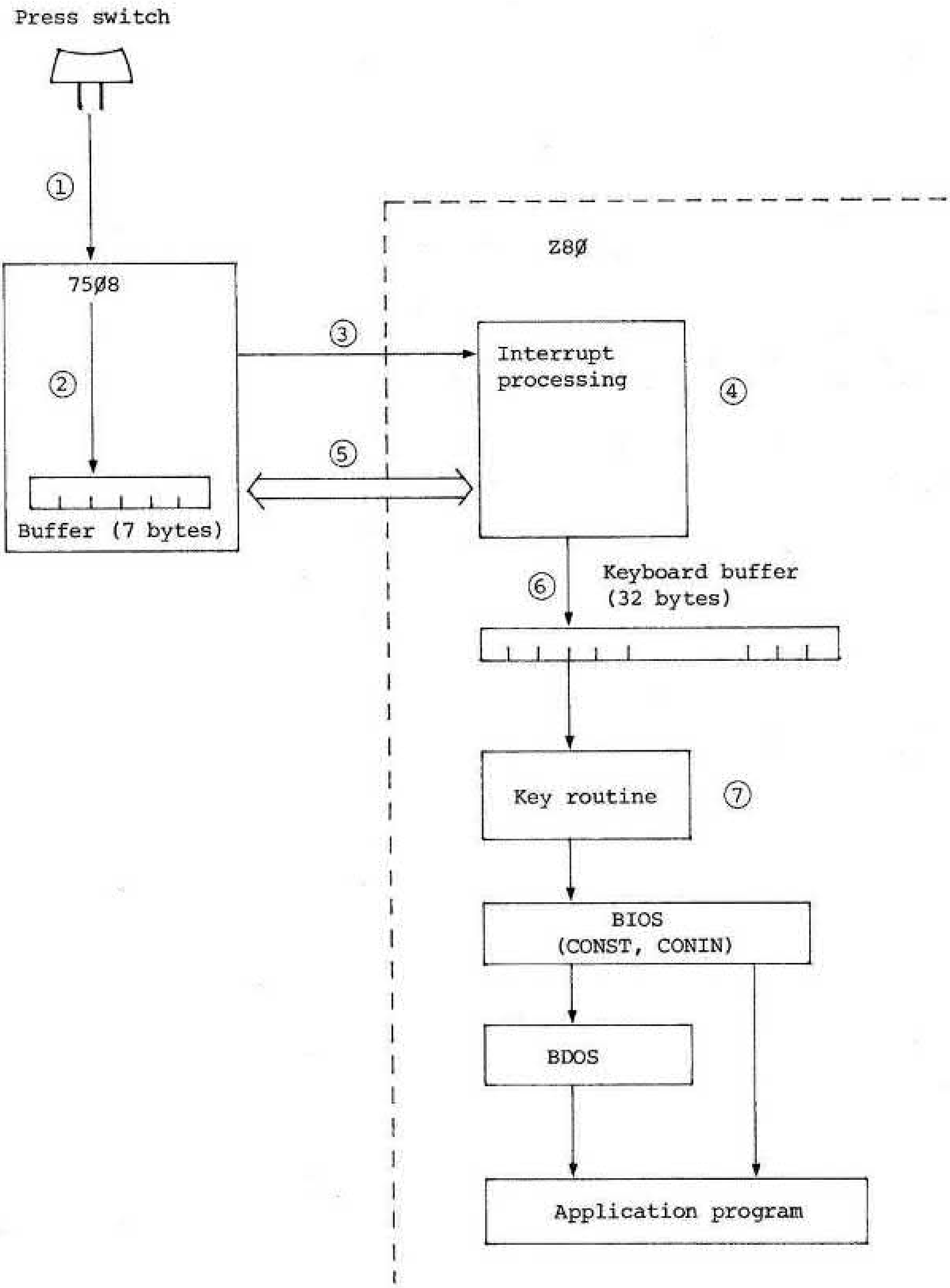
- Code for changing the keyboard mode ?
  (SHIFT key, CTRL key, etc.)
- PF key ?
- Subroutine call required?
  (CTRL/ESC - CTRL/PFK)

The above steps are illustrated in flowchart form on the next page.

* 7508 hardware codes

The 7508 hardware codes only identify the corresponding key on the keyboard and have no relation with the keyboard shift mode. Consequently, the key routine determines what code is actually entered according to the previously established state of the SHIFT, GRAPH, or CTRL key. (See Chapter 11 for details on hardware codes.)


Hardware code
PF key?
Y
N
Key for determining shift mode?
Y
N
Determine key code based on entered hardware code considering shift mode.
Perform key code conversion according to DIP switch settings specifying keyboard version.
Key code requiring a subroutine call?
Y
N
Get characters out of PF key string, one at a time.
Subroutine call.
Determine keyboard shift mode.
Return to BIOS.
Return to the beginning of key routine.


Press switch
①
75Ø8
②
Buffer (7 bytes)
③
⑤
Z8Ø
Interrupt processing
④
⑥
Keyboard buffer (32 bytes)
Key routine
⑦
BIOS (CONST, CONIN)
BDOS
Application program

5.5 Keyboard States

5.5.1 Keyboard Mode Transition

The MAPLE ASCII keyboard operates in three modes: Normal, CAPS and NUM. The Japanese-language OS supports the Kana mode in addition to these modes.

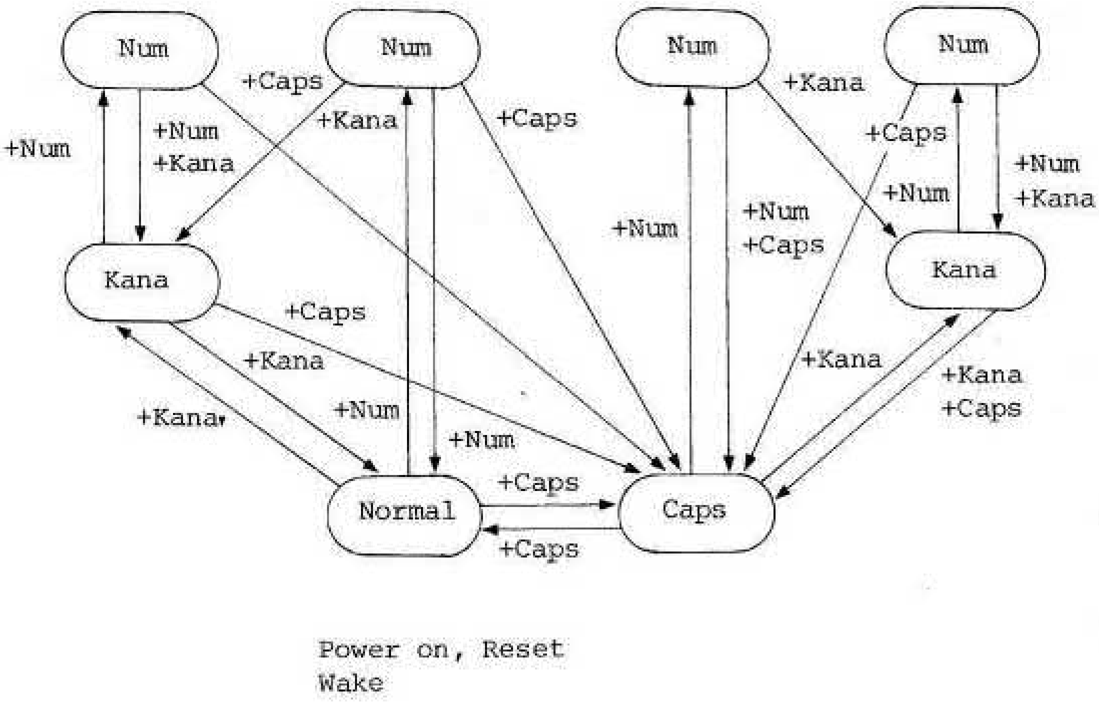
Normal: Unshifted letters are input in lowercase. For keys which have two characters on their keytop, lower letters are input.

CAPS: The same as the Normal mode except that unshifted letters are accepted in upper case.

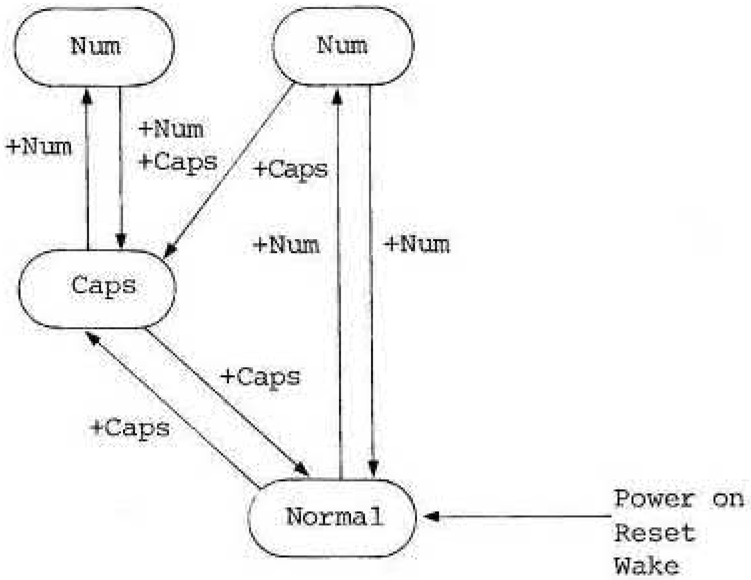
NUM: Numbers are input from the numeric keys which are aligned horizontally on the top of the keyboard or from the keys having a number indicated at the upper right of the keytop. Some symbols are also input. Other keys are ignored.

Kana: Kana characters are input.

Mode transition diagram (Kana keyboard)



Mode transition diagram (Keyboards except Kana and Japanese-language keyboards)

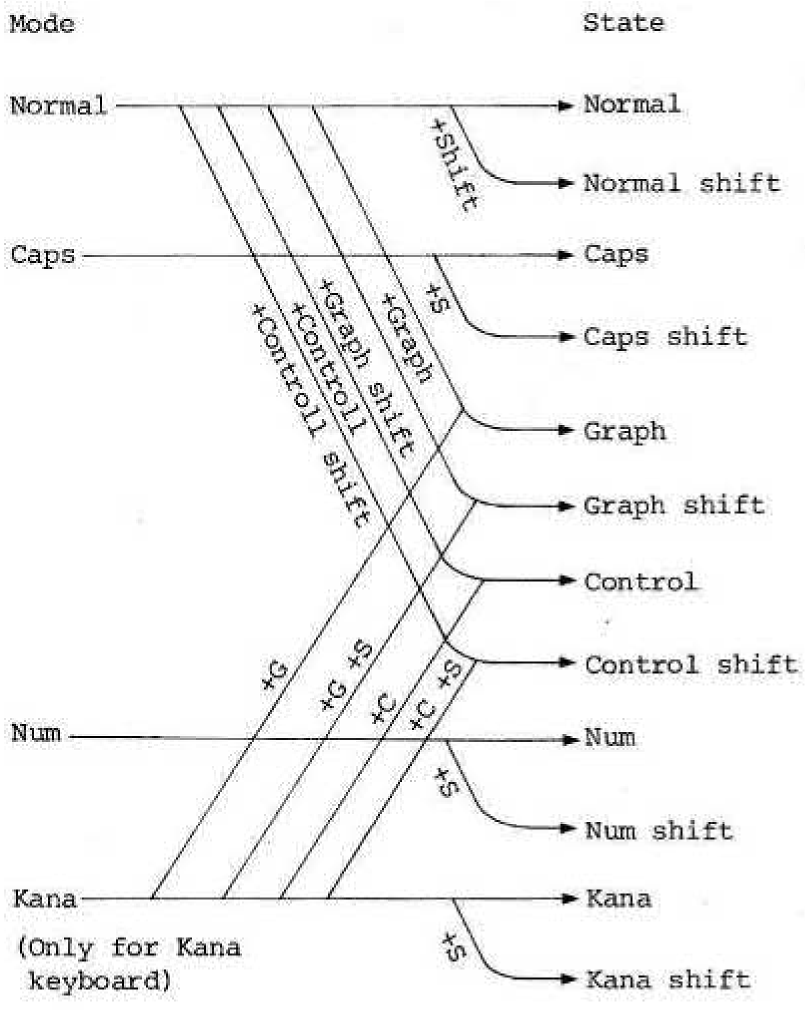


5.5.2 Keyboard State Transition

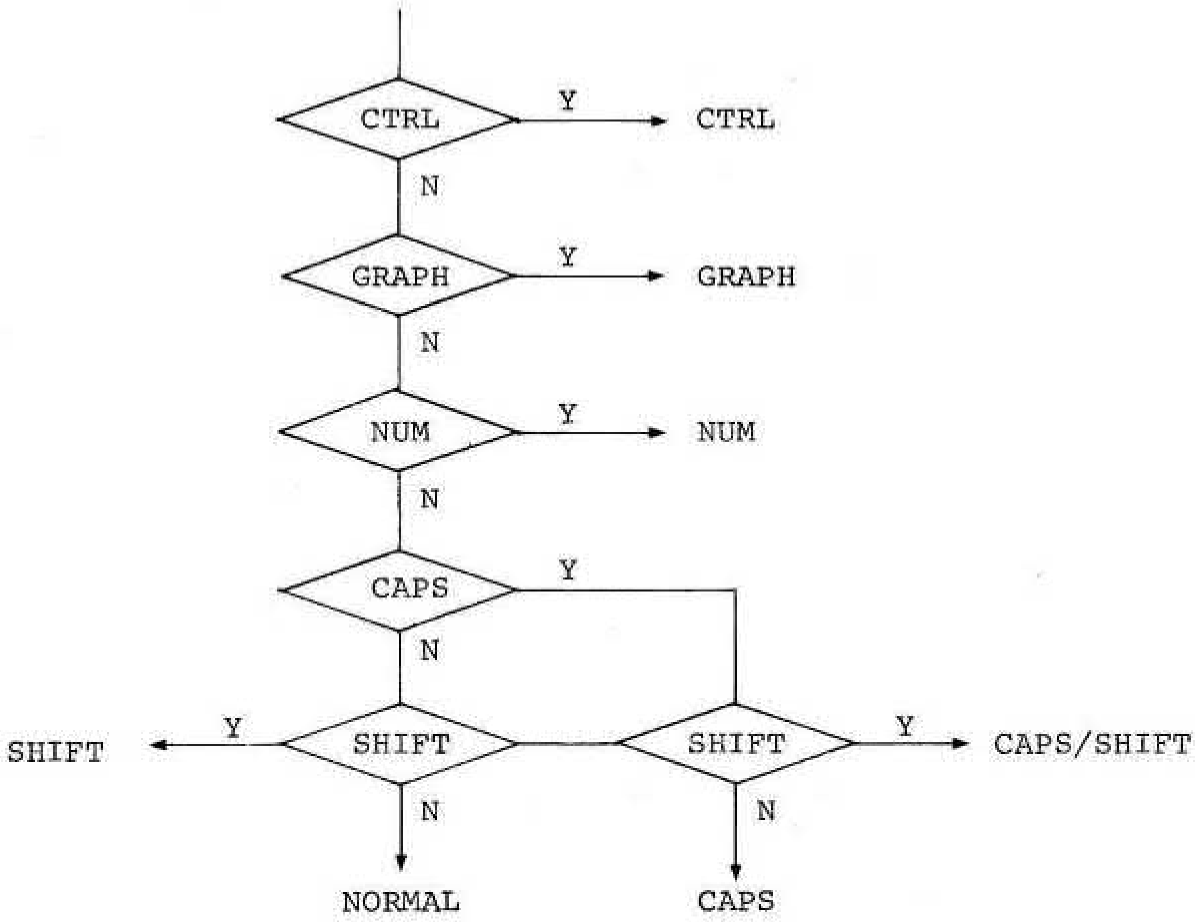
In any of the keyboard modes given in the previous subsection, a depression of a key returns different codes depending on whether the key is pressed singly or together with the SHIFT, GRPH, or CTRL key. The state transition diagram for the MAPLE keyboard is shown on the next page. The codes here refer to those codes which the application program receives from the keyboard through the BIOS CONIN function or a BDOS function.

Keyboard states (for Non-Japanese-language keyboards)

The keyboard state is determined by the combination of the keyboard mode and the state of the SHIFT, GRPH, and CTRL keys. The CTRL key has a higher priority than the GRPH key; i.e., if the CTRL and GRPH keys are pressed simultaneously, only the CTRL key is validated.



The codes received from keyboards may differ depending on the state in which the keyboard is.



The precedence of the mode keys are as follows:

1. CTRL
2. GRAPH
3. NUM
4. CAPS
5. SHIFT

The shift mode of a higher precedence is honored when two or more shift mode keys are pressed at the same time.

5.6 Special Keys

There are some keys which perform special functions besides returning a code when pressed. They are called special keys. The functions of the special keys are described below.

(1) STOP: Clears the key buffer and places only ^C (Ø3H) code into the buffer. Since the STOP key is normally used to interrupt program execution, when pressed, it clears all existing key codes except the ^C code off the buffer so that the MAPLE can respond immediately to this key. You can also enter ^C by typing C while holding down the CTRL key. In this case, the key buffer is not cleared at all.

(2) CTRL/STOP: This key sequence not only performs the above functions but also interrupt the current I/O operation such as an RS-232C receive operation. For example, press these keys to interrupt a program which is stalling, waiting for data from the RS-232C interface. The execution of the RS-232C receive routine is then interrupted and control is returned to the application program, which can then terminates itself by monitoring the ^C code.

Since both STOP and CTRL/STOP load the key buffer with 03H, it is impossible to tell which key was pressed from the contents of the key buffer alone. The key can be identified, however, by checking the following flags in the system work area:

CSTOPFLG --- Overseas version = F10BH

Japanese-language version = EE25H

= 00H: CTRL/STOP not pressed.

≠ 00H: CTRL/STOP pressed.

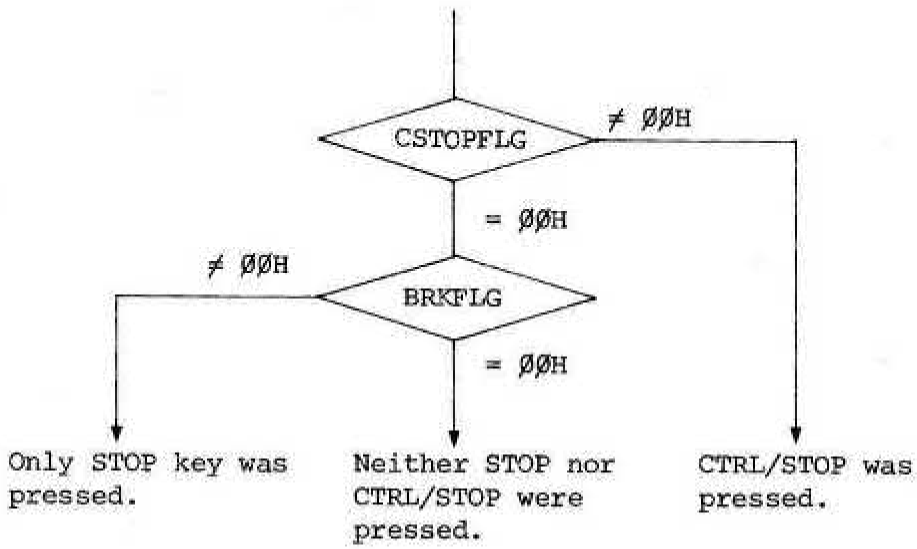
BRKFLG --- Overseas version = F10AH

Japanese-language version = EE24H

= 00H: STOP or CTRL/STOP not pressed.

≠ 00H: STOP or CTRL/STOP pressed.

Both CSTOPFLG and BRKFLG are set to 00H when the key buffer is cleared by CONIN.



(3) SHIFT/INS: Toggle between the tracking mode and non-tracking mode.

(4) CTRL/INS: Display the portion of the screen on which the cursor is currently positioned. This key sequence is used in non-tracking mode to scroll the screen up to the cursor position.

(5) Cursor movement keys (arrow keys)

There are four cursor movement keys: ↑, ↓, ←, and →. Since each of them may be pressed independently or in combination with the SHIFT or CTRL key, it may be assumed that there are logically twelve movement keys. The user can assign a code from 00H to 0FFH to each of these keys. Especially, the OS takes special actions when codes 80H and 0F8H to 0FFH are entered. These codes can be set by the application program sending ESC + F3H, ESC + F4H, and ESC + F5H via the CONOUT BIOS call.

Code	OS action
00H -------------	The key routine returns the code.
|	(Same as with ordinary keys.)
7FH	
80H --------------	No action.
81H --------------	The key routine returns the code.
|	(Same as with ordinary keys.)
0F7H	
0F8H -------------	Scrolls the screen one line up.
0F9H -------------	Scrolls the screen one line down.
0FAH -------------	Scrolls the screen one page (8 lines) up.

0FBH ------------- Scrolls the screen one page (8 lines) down.

0FCH ------------- Scrolls the screen to the top of the virtual screen.

0FDH ------------- Scrolls the screen to the bottom of the virtual screen.

0FEH ------------- Displays virtual screen 1.

0FFH ------------- Displays virtual screen 2.

The table below lists the initial values for the cursor movement keys.

Cursor movement keys	Initial value
→	1CH
←	1DH
↑	1EH
↓	1FH
SHIFT/ →	80H
SHIFT/ ←	80H
SHIFT/ ↑	F8H
SHIFT/ ↓	F9H
CTRL/ →	FFH
CTRL/ ←	FEH
CTRL/ ↑	FAH
CTRL/ ↓	FBH

(6) Programmable function keys

The keys PF1 to PF5 at the top of the keyboard are programmable function keys. They are used with or without the SHIFT key and are numbered PF6 (SHIFT/PF1) to PF10 (SHIFT/PF5) when used with the SHIFT key. Any string of up to 15 characters can be assigned to each of these keys in the following ways:

1) Using the BIOS PUTPFK (WBOOT + 6CH) function.

2) Defining a programmable function key table (160 bytes) having the same structure as that owned by the OS and storing its starting address in the first two bytes at YPFKSTR (0F103H) or at 0EDE9H for Japanese-language OS.

The user using the ASCII OS Version 1.0 must define the programmable function key table in a user area between addresses 8000H to 0FFFFH. If he is using the CP/M CCP area, however, he can define it in any user area at locations 8000H or higher. Those who use other operating systems may define the table anywhere in the user area.

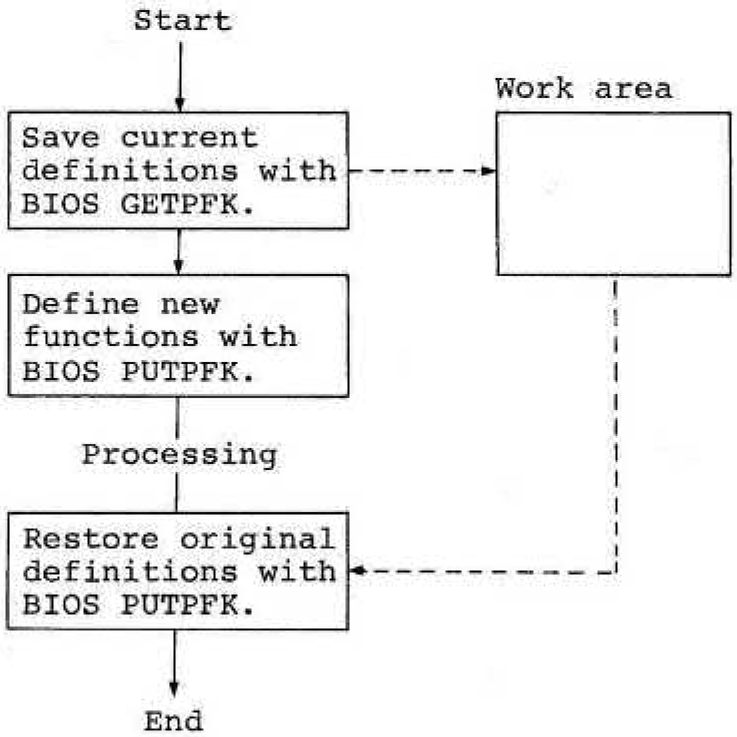
Programmable function key table

Ø3H	d	i	r													For PF1
Ø4H	t	y	p	e												For PF2
Ø4H	s	t	a	t												For PF3
Ø3H	p	i	p													For PF4
Ø6H	c	o	n	f	i	g										For PF5
Ø4H	d	u	m	p												For PF6
Ø6H	s	u	b	m	i	t										For PF7
Ø3H	d	d	t													For PF8
Ø5H	t	e	r	m	CR											For PF9
Ø7H	f	i	l	i	n	K	CR									For PF10

For string definition (15 bytes)

→ Indicates the string length (ØØH - ØFH). Loaded with ØØH when no string is defined.

Definitions made using the first method will be reserved until the next CBOOT (depression of the RESET switch) is executed. Therefore, if programmable function keys definitions are modified in an application program, the program must restore the table with the original definitions before terminating processing.



The second method causes the OS to restore the contents of YPFKSTR into its original programmable function key table when a WBOOT is executed. Application programs need not perform any special processing before termination.

The user is recommended to employ the second method because some application programs may unconditionally call WBOOT when a BDOS error occurs.

(7) Keys calling a subroutine

Predefined processing can be performed in the form of a subroutine call by pressing the ESC, PAUSE, HELP, or PF1 to PF5 key while holding down the CTRL key. Since the entries for such subroutines are managed in a table form, application programs can use their own key routines via key entries by changing the entry values in that table.

The starting address of the table is 0F1BAH for the overseas version and 0EED3H for the Japanese-language version.

Table structure

DW XXXX : CTRL/ESC subroutine entry

DW XXXX : CTRL/PAUSE subroutine entry

DW XXXX : CTRL/HELP subroutine entry

DW XXXX : CTRL/PF1 subroutine entry

DW XXXX : CTRL/PF2 subroutine entry

DW XXXX : CTRL/PF3 subroutine entry

DW XXXX : CTRL/PF4 subroutine entry

DW XXXX : CTRL/PF5 subroutine entry

The OS use the following two key subroutines:

CTRL/HELP: System display processing

CTRL/PF5: Hard copy processing

hapter 6 CONOUT

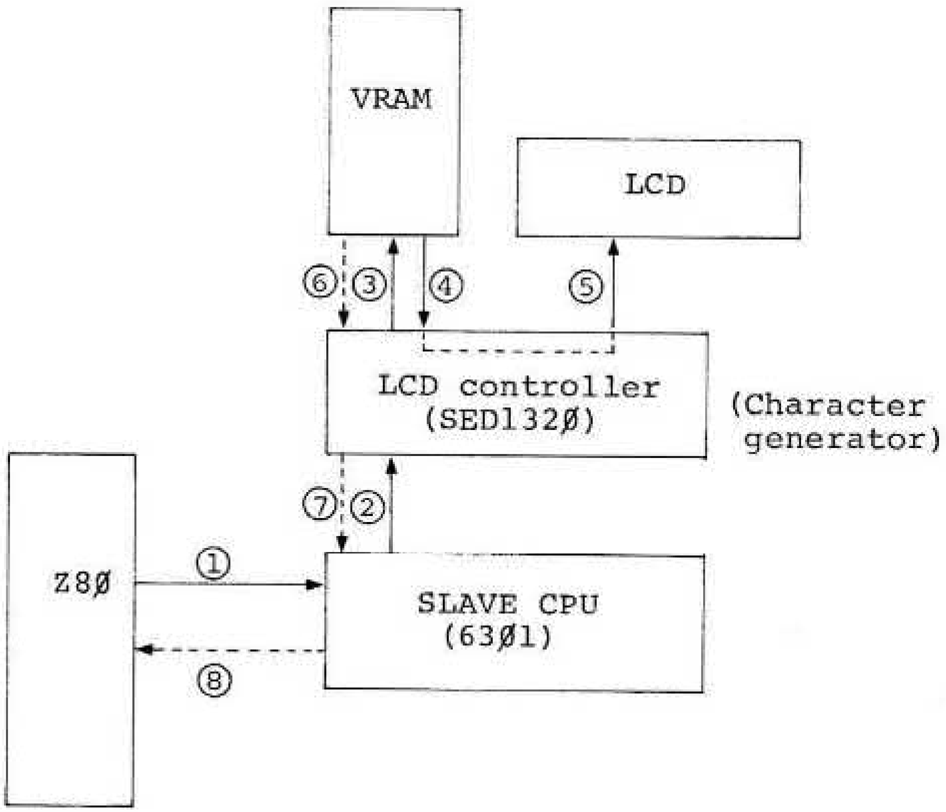
1 Outline

ıe MAPLE is provided with an LCD of 8 lines by 80 ›lumns as its primary display device. The MAPLE OS ıpports several screen modes to allow the user to make 'fective use of this LCD. This chapter describes the :reen modes in full detail.

6.2 Screen Configuration

The block diagram for the screen hardware and its peripheral devices is shown on the next page. The screen operation flow is as follows:

1) The program running on the Z80 CPU sends data to be displayed to the SLAVE CPU, directly or using the CONOUT function of BIOS (see Chapter 13, "SLAVE CPU"). (1 in the diagram on the next page.)
2) The SLAVE CPU loads the data into VRAM via the LCD controller (SED1320). (2 and 3 in the diagram.)
3) The LCD controller reads the data in VRAM and displays it on the LCD. (4 and 5 in the diagram.)



?he contents of VRAM can be read in the flow from 6 to
}.

:haracter fonts are stored in the LCD controller and
:heir corresponding codes in VRAM. The LCD controller
:eads the codes for specified characters from VRAM (4),
:onverts them into fonts, and sends them to the LCD (5).

?onts for external characters are defined at the
>eginning of VRAM so, if the code read from VRAM is an
:xternal character, the LCD controller reads the
:orresponding font from VRAM and transfers it to the
.CD.

See Chapter 13, "SLAVE CPU" for VRAM memory maps.

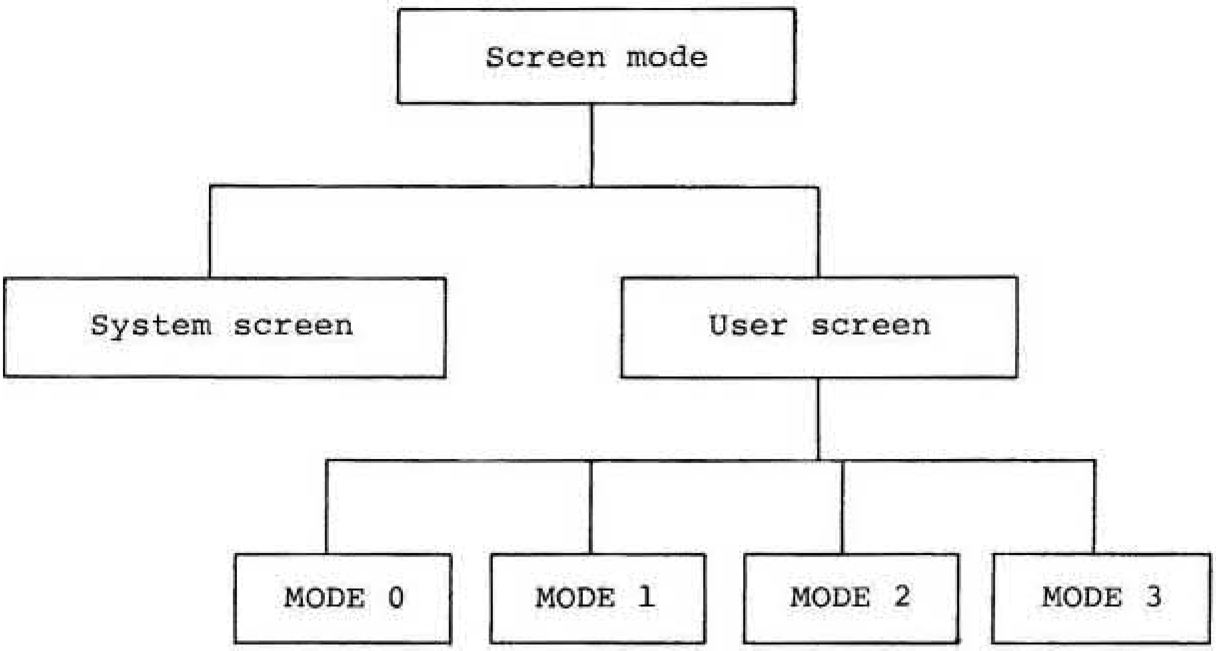
6.3 Screen Modes

1) System screen and user screen

MAPLE CP/M supports two types of screens; the system screen and the user screen. These two screens are independent of each other. That is, manipulating one screen does not affect the other screen at all.

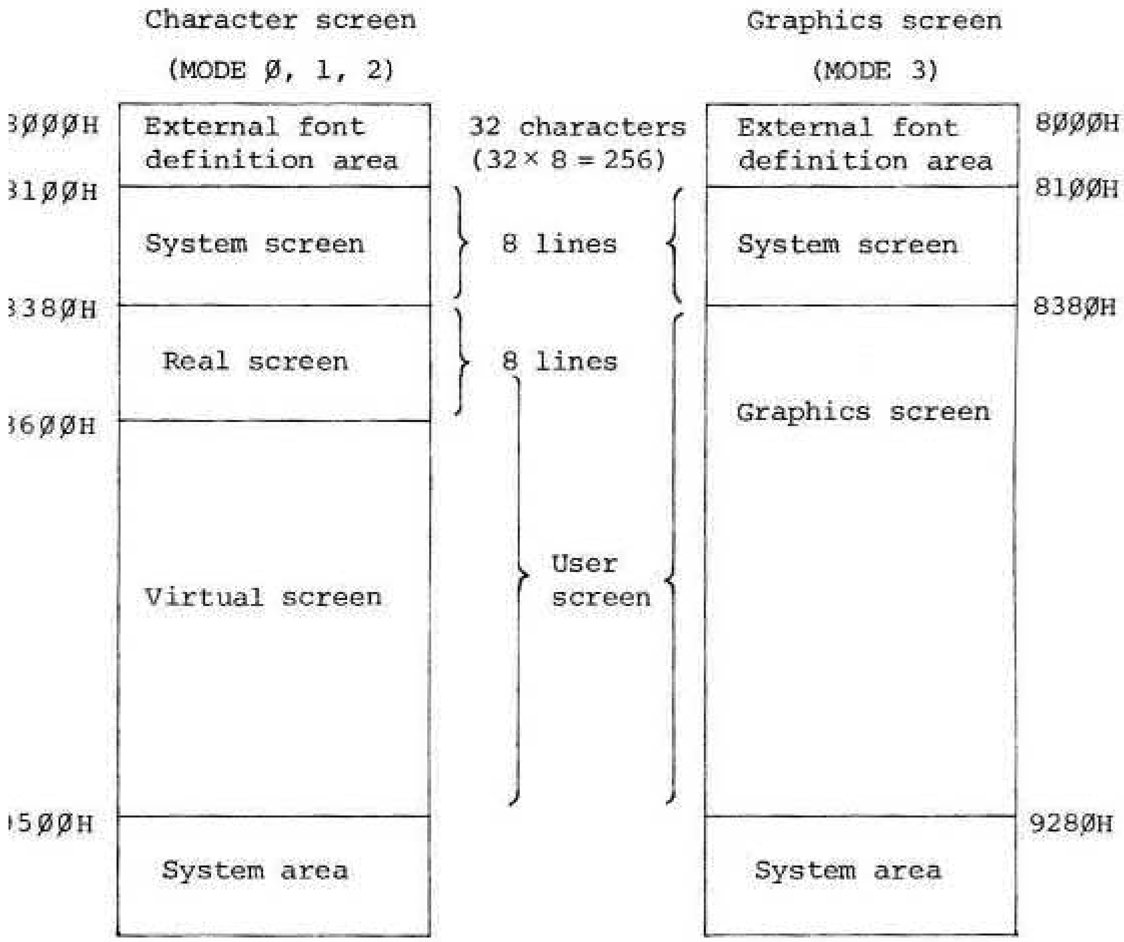
The user screen has four modes. (These modes are detailed later.)

A hierarchical diagram of the screen modes is shown below.



Relationship to VRAM

e screens are located in VRAM as shown below:



3) System screen

The system screen consists of 8 lines of 80 columns and is used by the OS to display:

- System Display
- Alarm/wake message
- Password entry prompt message
- "CHARGE BATTERY"

Usually, no application programs normally can send data onto the system screen.

) User screen concept

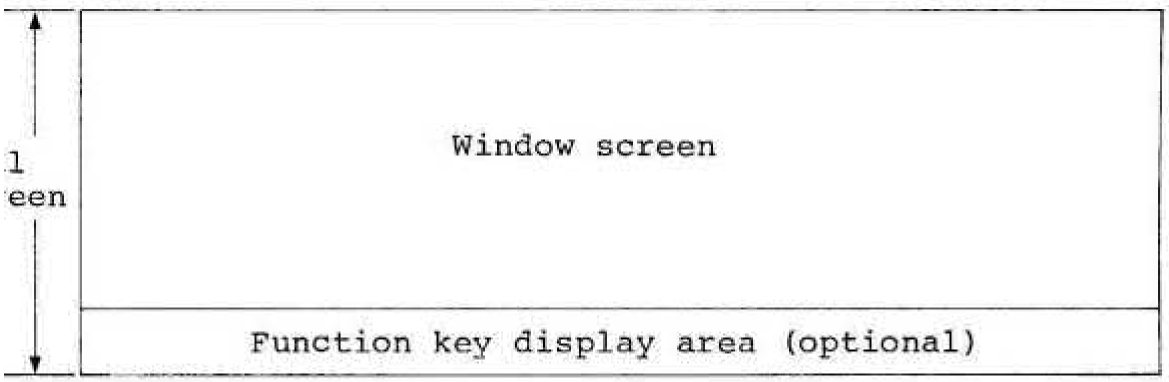
ıe user screen is divided into three screens: real, ırtual, and window screens.

(1) Real screen

The MAPLE LCD display can display 8 lines by 80 columns of data which makes up the real screen. The real screen consists of a window screen and a 1-line function key display area. The function key display area is optional. When no function key definitions are displayed, the real screen size equals the window screen size. From now on, the number of lines of the window screen is represented by h where h is 7 or 8.

(2) Window screen

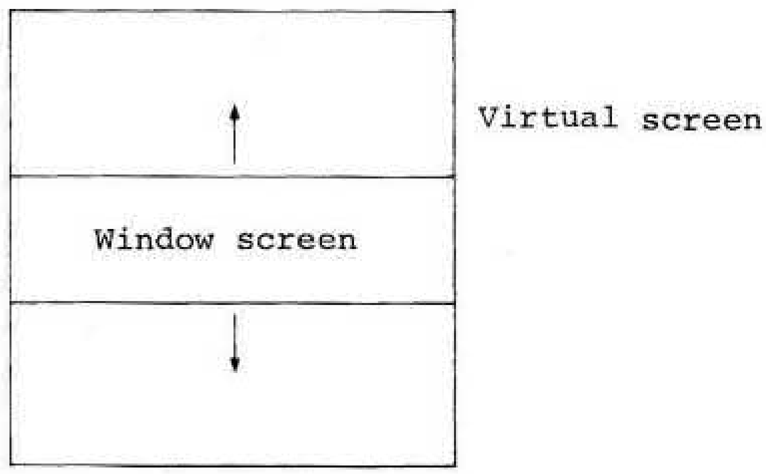
The window screen is included in the real screen and made up of h lines of 80 columns. The window screen works like a window through which h lines of the virtual screen can be viewed. This window screen can scroll up and down over the virtual screen.



(3) Virtual screen

Although the MAPLE has a large (8 lines of 80 columns) display screen for this type of display, it has implemented the concept of virtual screen to meet the needs of the applications programs which require larger screens. The MAPLE provides two virtual screens for the application programs. These screens may be used for different purposes and displayed alternately, e.g., displaying data on one screen while writing display data onto the other screen. The two screens may be displayed concurrently in some modes. The sizes of the virtual screens are determined by the screen mode and user specification.

The entire contents of a virtual screen can be viewed by scrolling the window screen up and down over the virtual screen. The window screen scrolls only vertically.



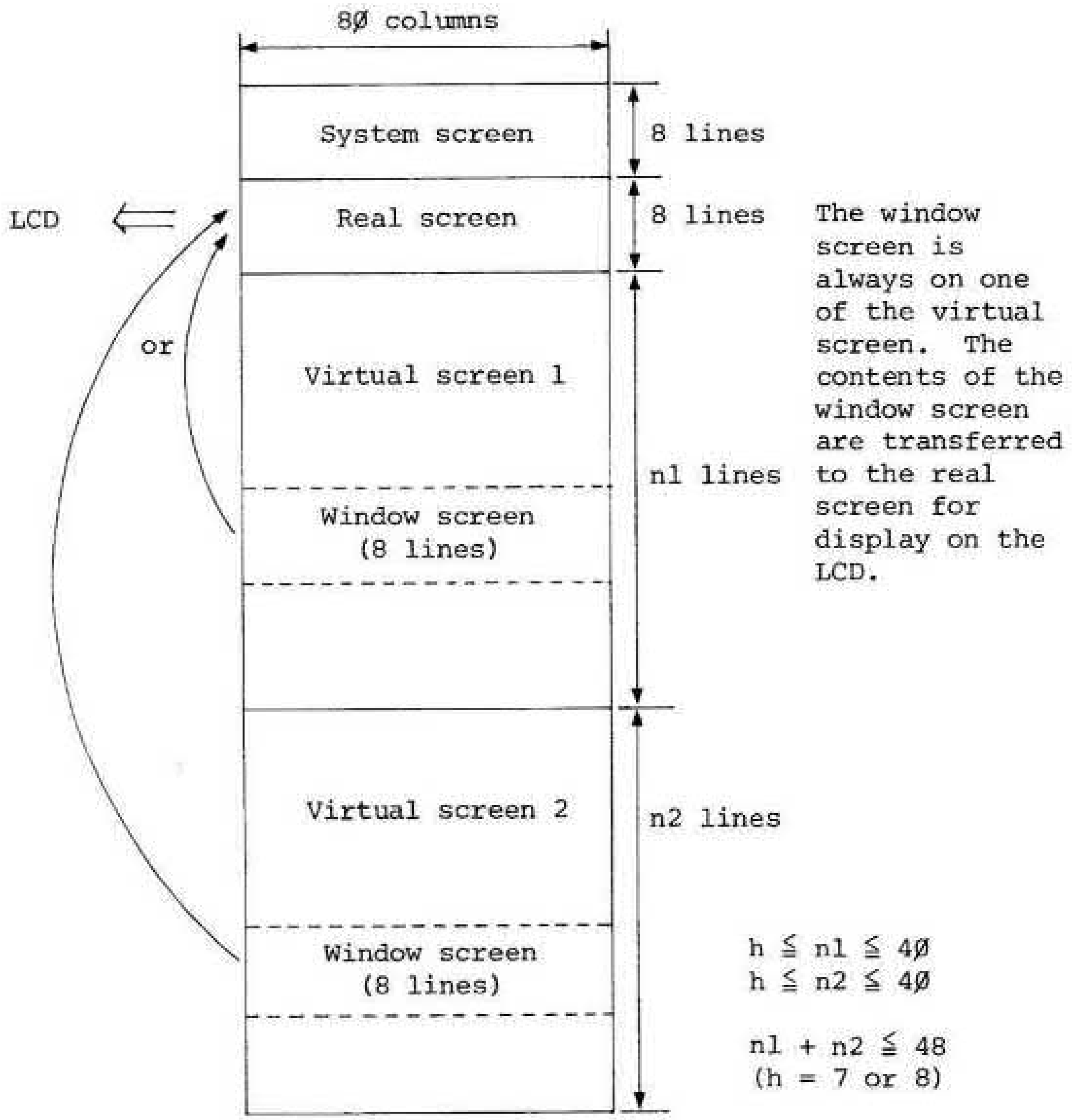
User screen modes

ere are four user screen modes numbered from MODE 0 to DE 3. MODE 0 to MODE 2 are character screen modes in ich only characters can be displayed. MODE 3 is a aphics screen mode in which both graphics and aracters can be displayed. Switching of screen modes n be easily performed using the BIOS call CONFIG or NOUT.

MODE 0 (80-column mode)

o 80-column wide virtual screens are available in this de. Their sizes may be defined as desired, as long as e screen consists of at least eight lines and their tal number of lines do not exceed 48. The window reen is always located on one of these virtual reens.

Screen RAM structure in MODE 0



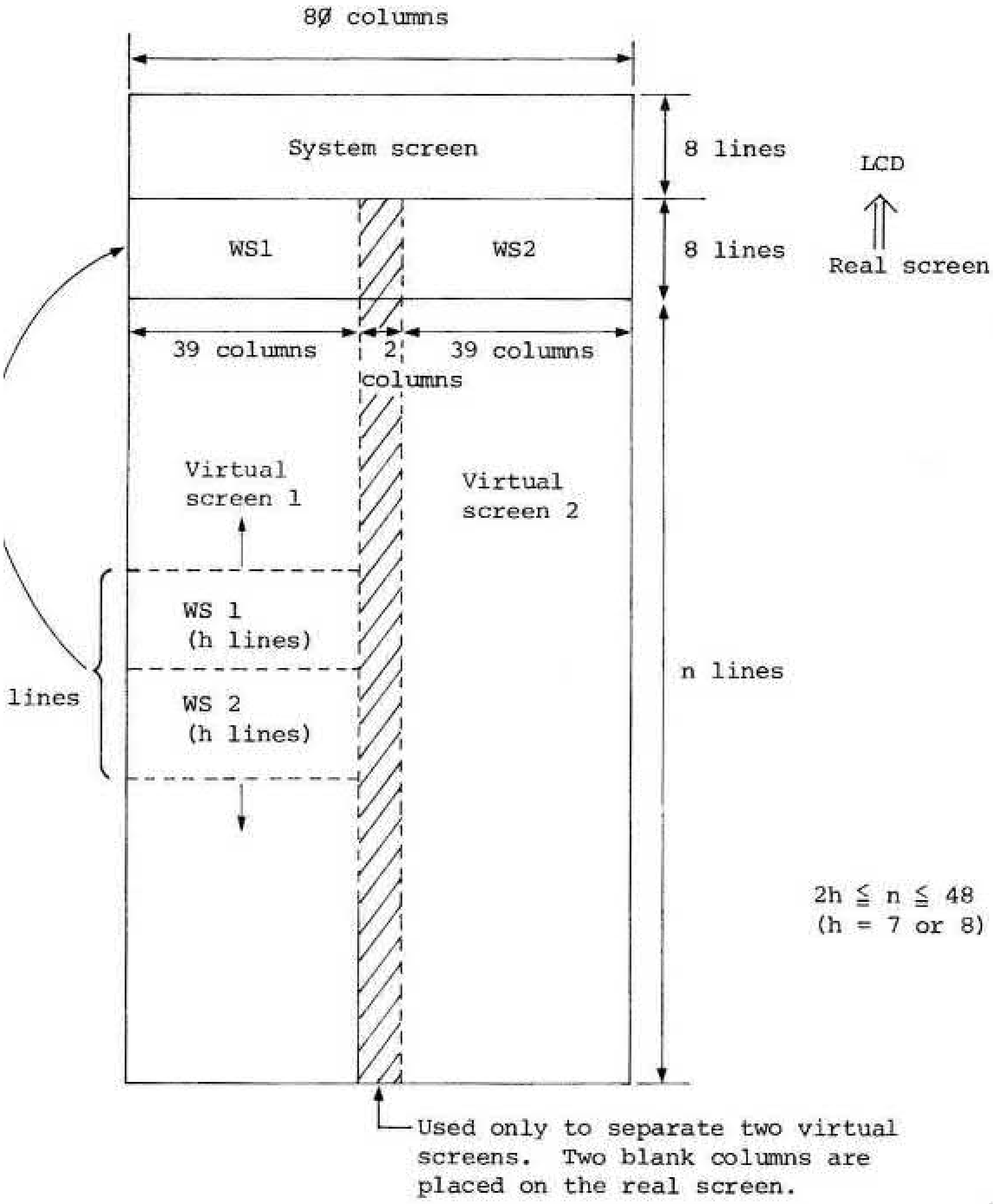
b) MODE 1 (39-column mode)

In this mode, either of the two virtual screens is 39 columns wide. The window screen (WS) has 2h lines. The first h lines of data is displayed on the left half of the real screen and the second h lines of data on the right half of the real screen.

The WS rests on one of the two virtual screens and can scroll up and down as required.

e two virtual screens can accommodate the same number lines in the range $2h \leqq n \leqq 48$.

Screen RAM structure in MODE 1

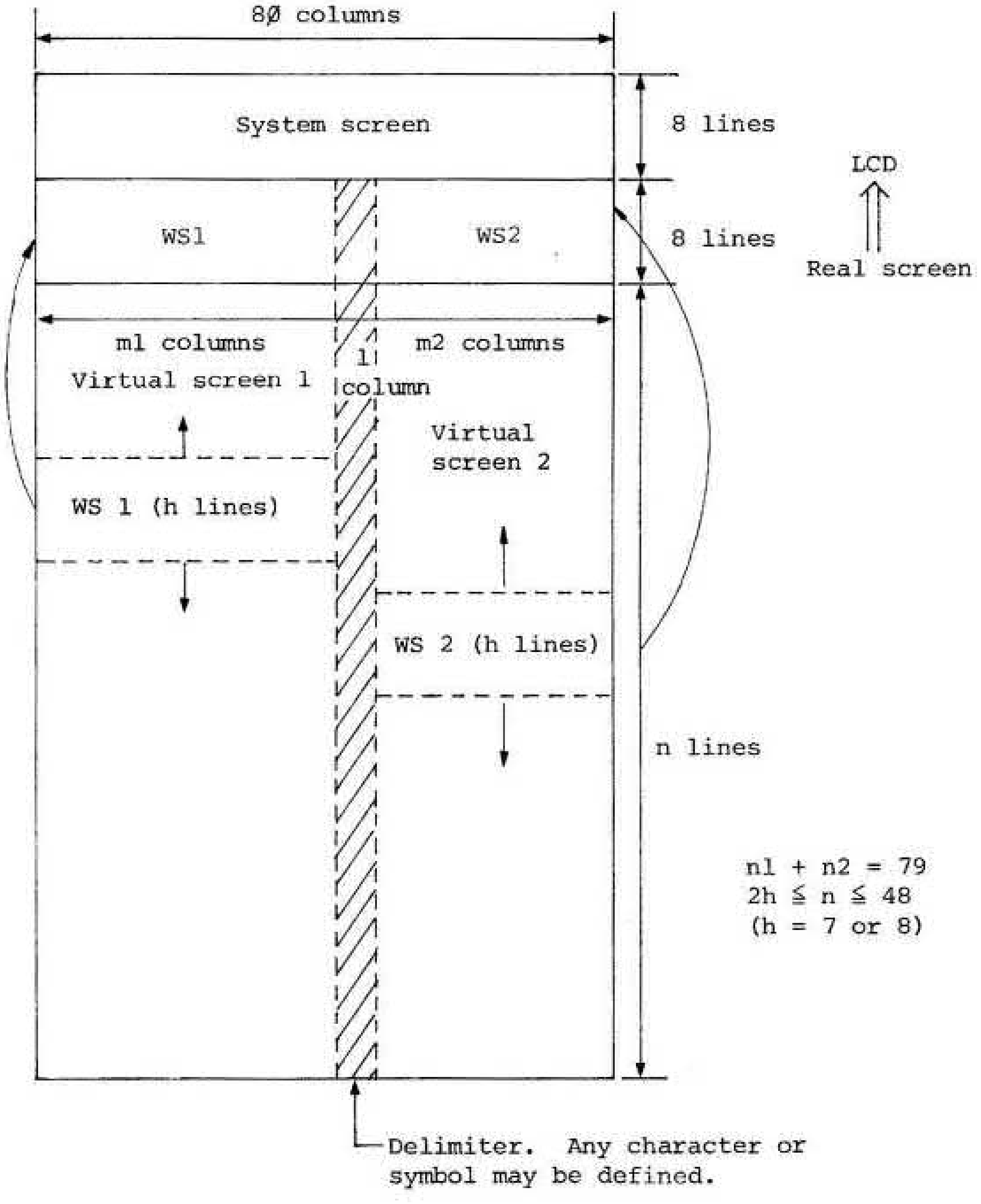


c) MODE 2 (Split screen)

In this mode, two virtual screens are available. Either of them may consist of any number of columns provided that the total number of columns is 79. Since each virtual screen is provided with its own window screen, the contents of the two virtual screens can be displayed on the real screen at the same time. These window screens can scroll independently over the associated virtual window.

Any character or symbol may be defined as the delimiter to separate the two virtual screens on the real screen.

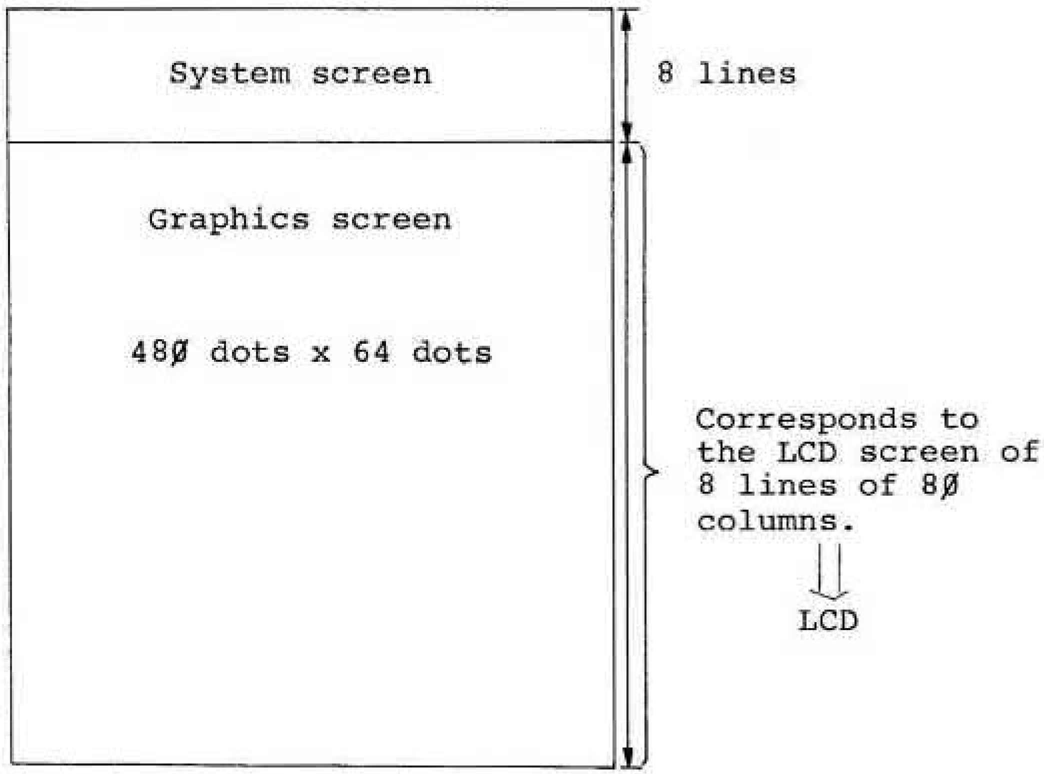
Screen RAM structure in MODE 2



d) MODE 3 (Graphics mode)

This mode permits the application program to display graphics patterns on a dot basis. In this mode, the VRAM is occupied by the 480 dots by 64 dots graphics screen. Accordingly, there can be only one user screen at a time. No virtual screen is supported and only a real screen is available in this mode.

Screen RAM structure in mode 3



.4 Special Screen Features

1) Display screen and write screen

s explained in the previous section, two virtual screens re supported in MODE Ø through MODE 2. However, data an be written only onto the screen in which the cursor s stationed (selected virtual screen). In MODE Ø and ODE 1, only one of the two virtual screens holding the ursor is displayed at a time.

nly one screen is supported in MODE 3 and used for both isplay and write.

2) Scroll mode

n character screen modes (MODE 0, 1, 2), the window creen scrolls up and down over the virtual screen in he tracking mode and non-tracking modes.

1) Tracking mode

In this mode, the window screen scrolls following the cursor. That is, the cursor is always in the window (real) screen.

2) Non-tracking mode

The window screen does not follow the cursor movement. The WS remains in the current position even if the cursor moves beyond the WS. The cursor stays in the virtual screen and newly entered data is placed at the cursor position.

When the mode is switched to the tracking mode, the WS continues to scroll until the cursor appears in the WS.

(3) Cursor functions and types

1) Character screen

Any combination of the following cursor functions and types are available on the character screen:

- Cursor display: ON/OFF
- Cursor type: Underline/block
- Cursor blink: ON/OFF

2) Graphics screen

The cursor type is preset to underline and nonblink on the graphics screen. The user can control only the cursor display ON/OFF state.

(4) Block flash (blink)

The displayed data can blink as the selected file name can on the MENU screen. Since this function is supported by the slave CPU, the block flash command must be issued directly to the slave CPU using the BIOS SLAVE call. For further information, see Chapter 13, "SLAVE CPU".

5) User defined characters

User characters can be defined under the following conditions:

Number of user defined characters: 32 maximum

User defined character codes: 0E0H - 0FFH

0E0H and 0E1H are used by the OS. Although the user can overwrite the OS defined characters under these two codes with his own characters, the user defined characters will be overwritten again by the OS defined characters if the RESET switch is pressed. User defined characters under the other codes remain unchanged when the RESET switch is pressed.

0E0H = "△"   0E1H = "↵"

Characters can be defined by sending the ESC + 0E0H sequence through the CONOUT routine.

User defined characters are displayed on the screen but not printed on the printer.

(6) Character sets

The MAPLE supports the character sets for the countries listed below. The user can select any of them by sending the ESC + "C" sequence via CONOUT. See the character set tables at the back of this manual.

- USASCII
- FRANCE
- GERMANY
- ENGLAND
- DENMARK
- SWEDEN
- ITALY
- SPAIN
- NORWAY

6.5 How to Use CONOUT

Display of data on the screen is primarily accomplished by the CONOUT BIOS call. Call the CONOUT using the following calling sequence:

Entry address = WBOOT + 09H

Entry parameter = Load into C reg.

The CONOUT supports various control codes and ESC sequences. The control codes and ESC sequences are fully described in the next section. When entering more than one data byte such as when sending an ESC sequence, call the CONOUT the required number of times with each data byte loaded in the C reg.

6.6 CONOUT Functions

The pages that follow list the CONOUT functions that the MAPLE OS supports to handle control codes or ESC sequences.

CONOUT SPECIFICATIONS (1)

CODE	FUNCTION	SYSTEM MODE	MODE 0/1/2	MODE 3
05H	ERASE END OF LINE	Deletes to the end of the line from the cursor position on the screen.	Deletes to the end of the line from the cursor position on the virtual screen in write operation.	Same as in system mode.
07H	BELL	Sounds the speaker at 44Ø Hz for 1 minute. In ASCII Ver. B, this function sounds the speaker for 2ØØ ms.	Same as in system mode.	Same as in system mode.
08H	BACK SPACE	Moves the cursor one position to the left. The cursor does not move if it is in the home position.	Moves the cursor one position to the left in the currently selected virtual screen. The cursor does not move when it is in the home position.	Same as in system mode.
09H	TAB	Does nothing.	Searches for the next tab position following the cursor position to the right in the currently selected virtual screen and moves the cursor to the first tab position encountered. When no tab position is found on the current line, the function moves the cursor to the beginning of the next line. Tab position = (1+8n) positions n = Ø, 1, 2 ...	Searches for the next tab position starting at the current cursor position on the screen to the right and moves the cursor to the first tab position encountered. When no tab position is found on the line, the function moves the cursor to the beginning of the next line. Tab position = (1+8n) positions n = Ø, 1, 2 ...
0AH	LINE FEED	Does nothing.	Moves the cursor down one line in the currently selected virtual screen. The function scrolls up one line when the cursor is on the bottom line of the virtual screen.	Moves the cursor down one line on the screen. The function scrolls up one line when the cursor is on the bottom line of the screen.

CONOUT SPECIFICATIONS (1)

CODE	FUNCTION	SYSTEM MODE	MODE 0/1/2	MODE 3
OBH	HOME	Moves the cursor to the upper left corner on the screen.	Moves the cursor to the upper left corner in the currently selected virtual screen. How the cursor behaves depends on the tracking/non-tracking specification.	Same as in system mode.
OCH	CLEAR SCREEN & HOME	Clears the entire screen and moves the cursor to the beginning of the screen.	Clears the entire virtual screen in write operation and moves the cursor to the beginning of the virtual screen on which the cursor rests. How the cursor behaves depends on the tracking/non-tracking specification.	Same as in system mode.
ODH	CARRIAGE RETURN	Moves the cursor to the first column of the current line. When a character has been displayed in the last column on the line, this function moves the cursor to the first column of the previous line (the line on which the last character was displayed).	Moves the cursor to the first column of the current line. When a character has been displayed in the last column on a line on the virtual screen, this function moves the cursor to the first column of the previous line (the line on which the last character was displayed).	Same as in system mode.

CONOUT SPECIFICATIONS (2)

CODE	FUNCTION	SYSTEM MODE	MODE 0/1/2	MODE 3
10H	SCREEN UP	Does nothing.	Moves up the window screen a screenful of lines (h lines) over the currently selected virtual screen. Display starts at the home position when it moves up beyond the home position. The cursor is held in the original position on the virtual screen.	Does nothing.
11H	SCREEN DOWN	Does nothing.	Moves down the window screen a screenful of lines (h lines) over the currently selected virtual screen. The last line of the virtual screen is set to the bottom of the window screen when display moves down beyond the end of the virtual screen. The cursor is held in the original position on the virtual screen.	Does nothing.
1AH	ERASE END OF SCREEN	Clears to end of the screen from the current cursor position.	Clears to the end of the virtual screen from the current cursor position.	Same as in system mode.
1BH	ESC	Receives the next code as the second parameter of an ESC sequence.	Same as in system mode.	Same as in system mode.

CONOUT SPECIFICATIONS (3)

CODE	FUNCTION	SYSTEM MODE	MODE 0/1/2	MODE 3
1CH	CURSOR RIGHT	Moves the cursor one position to the right on the screen. If the cursor is in the last column on a line, moves it to the beginning of the next line. This function does nothing when the cursor is in the last column of the last line on the screen.	Moves the cursor one position to the right in the currently selected virtual screen. When the cursor is in the last column on a line, moves it to the beginning of the next line. When the cursor is in the last column on the last line of the window screen, display automatically scrolls up one line in the tracking mode and goes beyond the screen in the non-tracking mode. The function does nothing when the cursor is in the last column of the last line on the virtual screen.	Same as in system mode.
1DH	CURSOR LEFT	Moves the cursor one position to the left on the screen. When the cursor is in the first column on a line, moves it to the last column on the previous line. This function does nothing when the cursor is in the home position on the screen.	Moves the cursor one position to the left in the currently selected virtual screen. When the cursor is in the first column on a line, moves it to the last column on the previous line. When the cursor is in the first column on the first line of the window screen, the display automatically scrolls down one line in the tracking mode or it goes beyond the screen in the non-tracking mode. The function does nothing when the cursor is in the home position on the virtual screen.	Same as in system mode.

CONOUT SPECIFICATIONS (3)

CODE	FUNCTION	SYSTEM MODE	MODE 0/1/2	MODE 3
1EH	CURSOR UP	Moves the cursor up one line on the screen. This function does nothing when the cursor is on the first line of the screen.	Moves the cursor up one line in the currently selected virtual screen. When the cursor is on the first line of the window screen, display automatically scrolls down one line in the tracking mode and goes beyond the screen in the non-tracking mode. The function does nothing when the cursor is on the first line of the virtual screen.	Same as in system mode.
1FH	CURSOR DOWN	Moves the cursor down one line on the screen. This function does nothing when the cursor is on the last line of the screen.	Moves the cursor down one line in the currently selected virtual screen. When the cursor is on the last line of the window screen, display automatically scrolls down one line in the tracking mode and goes beyond the screen in the non-tracking mode. The function does nothing when the cursor is on the last line of the virtual screen.	Same as in system mode.

CONOUT SPECIFICATIONS (4)

CODE	FUNCTION	SYSTEM MODE	MODE 0/1/2	MODE 3
ESC"%"	ACCESS CGROM DIRECTLY	Causes MAPLE CGROM to read the character associated with the specified code and displays it in the cursor position on the screen. (Command sequence) 1st byte: ESC 2nd byte: "%" 3rd byte: n $\emptyset \leqq n \leqq 255$	Causes MAPLE CGROM to read the character associated with the specified code and displays it in the cursor position in the currently selected virtual screen. (Command sequence) 1st byte: ESC 2nd byte: "%" 3rd byte: n $\emptyset \leqq n \leqq 255$	Same as in system mode.
ESC"(" ESC")"	PASS THROUGH	Does nothing.	Does nothing.	Does nothing.
ESC"*"	CLEAR SCREEN	Clears the screen and places the cursor in the home position.	Clears the currently selected virtual screen and places the cursor in the home position.	Same as in system mode.
ESC"0"	REVERSE ON	Does nothing.	Does nothing.	Does nothing.
ESC"1"	REVERSE OFF	Does nothing.	Does nothing.	Does nothing.
ESC"2"	CURSOR OFF	Suppresses the cursor display. The cursor can move, though invisible.	Same as in system mode.	Same as in system mode.
ESC"3"	CURSOR ON	Displays the cursor.	Same as in system mode.	Same as in system mode.
ESC"4"	UNDERLINE ON	Does nothing.	Does nothing.	Does nothing.
ESC"5"	UNDERLINE OFF	Does nothing.	Does nothing.	Does nothing.
ESC"6"	HIGHLIGHT ON	Does nothing.	Does nothing.	Does nothing.
ESC"7"	HIGHLIGHT OFF	Does nothing.	Does nothing.	Does nothing.

CONOUT SPECIFICATIONS (5)

CODE	FUNCTION	SYSTEM MODE	MODE 0/1/2	MODE 3
ESC"8"	BLINK ON	Does nothing.	Does nothing.	Does nothing.
ESC"9"	BLINK OFF	Does nothing.	Does nothing.	Does nothing.
ESC"<"	PUSH CURSOR POSITION	Does nothing.	Does nothing.	Does nothing.
ESC"="	SET CURSOR POSITION	Specifies the cursor position on the screen. (Command sequence) 1st byte: ESC 2nd byte: "=" 3rd byte: Row position (m + 31) 4th byte: Column position (n + 31) m and n indicates the position on the virtual screen, where its home position is (1,1).	Specifies the cursor position in the currently selected virtual screen. If the cursor goes off the screen in the tracking mode, this function redisplays the screen so that the cursor appears in the center of the screen. (Command sequence) 1st byte: ESC 2nd byte: "=" 3rd byte: Row position (m + 31) 4th byte: Column position (n + 31) m and n indicates the position on the virtual screen, where its home position is (1,1).	Same as in system mode.
ESC">"	POP CURSOR POSITION	Does nothing.	Does nothing.	Does nothing.

CONOUT SPECIFICATIONS (5)

CODE	FUNCTION	SYSTEM MODE	MODE Ø/1/2	MODE 3
ESC"C"	SET CHARACTER-SET TABLE	Does nothing under the Japanese-language OS. Under the OS for other countries, this function sets up the specified character set. (Command sequence) 1st byte: ESC 2nd byte: "C" 3rd byte: Country Identification Character U: USASCII F: FRANCE G: GERMANY E: ENGLAND D: DENMARK W: SWEDEN I: ITALY S: SPAIN N: NORWAY	Same as in system mode.	Same as in system mode.
ESC"L"	CHANGE CRT COLOR	Does nothing. In new ASCII version (M25Ø3ØCB) kana mode, this function displays the parameters as they are (garbage data).	Same as in system mode.	Same as in system mode.

CONOUT SPECIFICATIONS (6)

CODE	FUNCTION	SYSTEM MODE	MODE 0/1/2	MODE 3
ESC"P"	SCREEN DUMP	Produces a hard copy of the screen on the printer.	Produces a hard copy of the current window screen on the printer.	Same as in system mode.
ESC"T"	ERASE END OF LINE	Deletes to the end of the line from the cursor position on the screen.	Deletes to the end of the line from the cursor position in the currently selected virtual screen.	Same as in system mode.
ESC"Y"	ERASE END OF SCREEN	Clears to the end of the screen from the current cursor position.	Clears to the end of the virtual screen from the current cursor position.	Same as in system mode.
ESC 7BH	SECRET	Changes the subsequent output characters to spaces.	Same as in system mode.	Same as in system mode.
ESC 7DH	NON SECRET	Cancels the above mode.	Same as in system mode.	Same as in system mode.
ESC 80H	1BYTE CODE TO 2BYTE CODE (KATAKANA)	Does nothing. In new ASCII version (M25Ø3ØCB) kana mode, this function displays the parameters as they are (garbage data).	Same as in system mode.	Same as in system mode.
ESC 81H	1BYTE CODE TO 2BYTE CODE (HIRAGANA)	Does nothing. In new ASCII version (M25Ø3ØCB) kana mode, this function displays the parameters as they are (garbage data).	Same as in system mode.	Same as in system mode.
ESC 82H	2BYTE CODE TO 2BYTE CODE	Does nothing. In new ASCII version (M25Ø3ØCB) kana mode, this function displays the parameters as they are (garbage data).	Same as in system mode.	Same as in system mode.

CONOUT SPECIFICATIONS (7)

CODE	FUNCTION	SYSTEM MODE	MODE 0/1/2	MODE 3
ESC 90H	PARTIAL SCROLL UP	Does nothing.	(Command sequence) 1st byte: ESC 2nd byte: 9ØH 3rd byte: n-1 (Ø ≦ (n-1) ≦ R-1) 4th byte: m (1 ≦ m ≦ R) (n-1) + (m-1) < R, where R is the number of the lines on the virtual screen in mode Ø, 1, or 2 and the number of the lines on the window screen in mode 3. One character line is made up of 8 dot lines. The m-line screen segment from the nth line scrolls up one line as the above command sequence is processed. The (n+m-1)th line is left blank.	
ESC 91H	PARTIAL SCROLL DOWN	Does nothing.	(Command sequence) 1st byte: ESC 2nd byte: 91H 3rd byte: n-1 (Ø ≦ (n-1) ≦ R-1) 4th byte: m (1 ≦ m ≦ R) (n-1) + (m-1) < R, where R is the number of the lines on the virtual screen in mode Ø, 1, or 2 and the number of the lines on the window screen in mode 3. One character line is made up of 8 dot lines. The m-line screen segment from the nth line scrolls down one line as the above command sequence is processed. The nth line is left blank.	
ESC 92H	SCROLL RIGHT n character	Does nothing. In new ASCII version (M25Ø3ØCB) kana mode, this function displays the parameters as they are (garbage data).	Same as in system mode.	Same as in system mode.
ESC 93H	SCROLL LEFT n character	Does nothing. In new ASCII version (M25Ø3ØCB) kana mode, this function displays the parameters as they are (garbage data).	Same as in system mode.	Same as in system mode.

CODE	FUNCTION	SYSTEM MODE	MODE 0/1/2	MODE 3
ESC 94H	SET SCROLL STEP	Does nothing.	Specifies the number of lines to scroll when the scroll up or down n line (ESC 96H or 97H) function is executed. (Command sequence) 1st byte: ESC 2nd byte: 94H 3rd byte: Number of lines to be scrolled (n) $1 \leqq n \leqq h$ (h = number of window lines)	Does nothing.
ESC 95H	SET SCROLL MODE	Does nothing.	Enables and disables the automatic scroll. The modes in which the automatic scroll is enabled and disabled are called "tracking mode" and "non-tracking mode," respectively. The default is tracking mode. (Command sequence) 1st byte: ESC 2nd byte: 95H 3rd byte: mode Ø (tracking mode) or 1 (non-tracking mode)	Does nothing
ESC 96H	SCROLL UP n LINES	Does nothing.	Moves up the window screen n lines over the virtual screen on which the cursor rests. Display starts in the home position when it moves up beyond the home position. The cursor is held in the original position on the virtual screen. The value of n is specified by the ESC 94H sequence. The default value is 1.	Does nothing.

CODE	FUNCTION	SYSTEM MODE	MODE 0/1/2	MODE 3
ESC 97H	SCROLL DOWN n LINES	Does nothing.	Moves down the window screen a screenful of lines (n lines) over the virtual screen on which the cursor rests. The last line of the virtual screen is set to the bottom of the window screen when display moves down beyond the end of the virtual screen. The cursor is held in the original position on the virtual screen. The value of n is specified by the ESC 94H sequence. The default value is 1.	Does nothing.

CONOUT SPECIFICATIONS (9)

CODE	FUNCTION	SYSTEM MODE	MODE 0/1/2	MODE 3
ESC 0A0H	INS LED ON	Turns on the insert mode LED.	Same as in system mode.	Same as in system mode.
ESC 0A1H	INS LED OFF	Turns off the insert mode LED.	Same as in system mode	Same as in system mode.
ESC 0A2H	CAPS LOCK LED ON	Turns on the CAPS LOCK LED.	Same as in system mode.	Same as in system mode.
ESC 0A3H	CAPS LOCK LED OFF	Turns off the CAPS LOCK LED.	Same as in system mode.	Same as in system mode.
ESC 0A4H	NUM LED ON	Turns on the NUM input LED.	Same as in system mode.	Same as in system mode.
ESC 0A5H	NUM LED OFF	Turns off the NUM input LED.	Same as in system mode.	Same as in system mode.
ESC 0B0H	FUNCTION KEY CHECK MODE ON	Enables the programmable function key (PF keys) entry. (YPFCMFLG is set to ØFFH.) (Return code) When the C register is loaded with Ø, the ASCII code corresponding to the pressed key other than PF keys is returned to the A register. When the C register is loaded with ØFFH, one of the following codes associated with PF1 to PF1Ø, is returned to the A register. OS for the countries other than Japan: ØEØH - ØE9H OS for Japan: ØCØH - ØC9H	Same as in system mode.	Same as in system mode.
ESC 0B1H	FUNCTION KEY CHECK MODE OFF	Disables the programmable function key entry. (YPFCMFLG is set to Ø.) When a programmable function key is pressed, the associated string is returned.	Same as in system mode.	Same as in system mode.

CODE	FUNCTION	SYSTEM MODE	MODE 0/1/2	MODE 3
ESC 0C6H	DOT LINE WRITE	Does nothing.	Does nothing.	Draws a line of user-specified dot pattern on the LCD screen. (Command sequence) 1st byte: ESC 2nd byte: ØC6H 3rd byte: Starting position (horizontal) < H > m1 4th byte: Starting position (horizontal) < L > 5th byte: Starting position (vertical)< H > m2 6th byte: Starting position (vertical) < L > 7th byte: Ending position (horizontal) < H > n1 8th byte: Ending position (horizontal) < L > 9th byte: Ending position (vertical) < H > n2 1Øth byte: Ending position (vertical < L > 11th byte: Mask pattern 1 12th byte: Mask pattern 2 13th byte: Operation where: $\|m1-n1\| < 16383$ $\|m2-n2\| < 16383$ The pattern must be specified in bit image in 16 bits from mask pattern 1, bit 7 through mask pattern 2, bit Ø. Line segments are masked sequentially by this mask pattern in the mode specified by operation. The dot coordinates pf a slanted line.

CODE	FUNCTION	SYSTEM MODE	MODE 0/1/2	MODE 3
				are automatically calculated by the function. (Operation) Operation specifies the mode in which the dot coordinates corresponding to the 1 bits of the (16-bit) mask pattern are to be masked. The operation codes are: 1 = Off 2 = On 3 = Complement See separate sheets for dot coordinates.

CODE	FUNCTION	SYSTEM MODE	MODE 0/1/2	MODE 3
ESC 0C7H	PSET/PRESET	Does nothing.	Does nothing.	Sets and resets the specified point on the LCD screen. (Command sequence) 1st byte: ESC 2nd byte: ØC7H 3rd byte: Function code 4th byte: Plot position (vertical) n1 5th byte: Plot position (horizontal) < H > 6th byte: Plot position (horizontal) < L >n2 Ø ≦ n1 ≦ 63, Ø ≦ n2 ≦ 479 Function code: 1 = PSET (ON) Ø = PRESET (OFF)
ESC 0D0H	DISPLAY MODE SET	Does nothing.	Changes the screen mode and clears the screen. Mode Ø (Command sequence) 1st byte: ESC 2nd byte: ØDØH 3rd byte: Mode [Ø] 4th byte: Number of lines on VS1, n1 5th byte: Number of lines on VS2, n2 n1 + n2 ≦ 48, n1, n2 ≦ 8 The number of columns on VS1 and VS2 is 8Ø. Mode 1 (Command sequence) 1st byte: ESC 2nd byte: ØDØH 3rd byte: Mode [1] 4th byte: Number of lines on VS1, n	Mode 2 (Command sequence) 1st byte: ESC 2nd byte: ØDØH 3rd byte: Mode [2] 4th byte: Number of lines on VS1, n 5th byte: Number of columns on VS1, m 6th byte: Screen delimiter 8 ≦ n ≦ 48, 1 ≦ m ≦ 78 VS1 and VS2 have the same number of lines. VS2 = 79 - (number of columns on VS1) Mode 3 (Command sequence) 1st byte: ESC 2nd byte: ØDØH

CONOUT SPECIFICATIONS (11)

CODE	FUNCTION	SYSTEM MODE	MODE 0/1/2	MODE 3
			$16 \leqq n \leqq 48$ The number of columns on VS1 and VS2 are 39.	3rd byte: Mode [3]
ESC 0D1H	SELECT DISPLAY SCREEN	Does nothing.	Specifies which virtual screen is to be displayed. (Command sequence) 1st byte: ESC 2nd byte: ØD1H 3rd byte: Ø/1 Ø = VS1 1 = VS2 The default is VS1.	Does nothing.

CODE	FUNCTION	SYSTEM MODE	MODE 0/1/2	MODE 3
ESC 0D2H	DIRECT DISPLAY OF PHYSICAL SCREEN	Displays a specified character in the specified position on the real screen. (Command sequence) 1st byte: ESC 2nd byte: ØD2H 3rd byte: Row position (1-8) 4th byte: Column position (1-8Ø) The position must be specified with column and row numbers. This function displays a character directly in any location on the 8Ø × 8 screen. This function uses not internal but CG codes.	Same as in system mode.	Same as in system mode.
ESC 0D3H	SELECT FUNCTION KEY DISPLAY	Specifies whether or not function key definitions are to be displayed on the screen. (Command sequence) 1st byte: ESC 2nd byte: ØD3H 3rd byte: Ø/1 Ø = Displayed (The window screen has 7 lines.) 1 = Not displayed (The window screen has 8 lines.)	Same as in system mode.	Same as in system mode.
ESC 0D4H	LOCATE TOP OF SCREEN	Dos nothing.	Sets the window screen to the beginning of the virtual screen on which the cursor rests. The cursor is held in the original position.	Does nothing.

CONOUT SPECIFICATIONS (12)

CODE	FUNCTION	SYSTEM MODE	MODE 0/1/2	MODE 3
ESC 0D5H	LOCATE END OF SCREEN	Does nothing.	Sets the window screen to the end of the virtual screen on which the cursor rests. The cursor is held in the original position.	Does nothing.

<table>
<tr><th>CODE</th><th>FUNCTION</th><th>SYSTEM MODE</th><th>MODE 0/1/2</th><th>MODE 3</th></tr>
<tr><td>ESC
0D6H</td><td>SELECT CURSOR KIND</td><td>Used to select the type of the cursor.
(Command sequence)
1st byte: ESC
2nd byte: ØD6H
3rd byte: Type of the cursor [Ø/1/2/3]
Ø = Block and blink
1 = Block and nonblink
2 = Underline and blink
3 = Underline and nonblink
The default is Ø.</td><td>Same as in system mode.</td><td>Does nothing. (Set to the nonblink underline cursor.)</td></tr>
<tr><td>ESC
0D7H</td><td>FIND CURSOR</td><td>Does nothing.</td><td>Moves the window screen to the cursor position over the virtual screen so that the cursor line will appear near the center of the screen.</td><td>Does nothing.</td></tr>
<tr><td>ESC
0E0H</td><td>SET DOWN LOAD CHARACTER</td><td>Does nothing.</td><td colspan="2">Defines external characters with the codes ØEØH - ØFFH.
(Command sequence)
1st byte: ESC
2nd byte: ØEØH
3rd byte: Character code (ØEØH - ØFFH)
4th byte: Character pattern (1) ... | ** | 1 (Pattern 1)
5th byte: Character pattern (2) ... | * * | 2 (Pattern 2)
6th byte: Character pattern (3) ... |*   *| 3 (Pattern 3)
7th byte: Character pattern (4) ... |*   *| 4 (Pattern 4)
8th byte: Character pattern (5) ... |******| 5 (Pattern 5)
9th byte: Character pattern (6) ... |*   *| 6 (Pattern 6)
1Øth byte: Character pattern (7) ... |*   *| 7 (Pattern 7)
11th byte: Character pattern (8) ... |*   *| 8 (Pattern 8)
(ROW SCAN)
54321Ø (bit position)
The lowest 6 bits are used to display a character pattern.</td></tr>
</table>

CONOUT SPECIFICATIONS (14)

CODE	FUNCTION	SYSTEM MODE	MODE Ø/1/2	MODE 3
ESC 0F0H	KEYBOARD REPEAT ON/OFF	Does nothing.	Controls the keyboard repeat function (accepting inputs repeatedly while the key is held down). The default is REPEAT ON. (Command sequence) 1st byte: ESC 2nd byte: ØFØH 3rd byte: <Ø/1> where Ø = REPEAT OFF 1 = REPEAT ON	
ESC 0F1H	SET KEYBOARD REPEAT START TIME	Does nothing.	Specifies the keyboard repeat start time (the interval between the time the first character is entered and the time the second character is taken in when a key is held down). (Command sequence) 1st byte: ESC 2nd byte: ØF1H 3rd byte: n where $1 \leqq n \leqq 127$ time = n/64 SEC The default value is approx. 656 ms.	
ESC 0F2H	SET KEYBOARD REPEAT INTERVAL TIME	Does nothing.	Specifies the keyboard repeat interval time. (Command sequence) 1st byte: ESC 2nd byte: ØF2H 3rd byte: n where $1 \leqq n \leqq 127$ time = n/256 SEC The default is about 7Ø ms.	

CONOUT SPECIFICATIONS (14)

CODE	FUNCTION	SYSTEM MODE	MODE 0/1/2	MODE 3
ESC 0F3H	SET ARROW KEY CODE	Does nothing.	Defines the arrow key codes. (Command sequence) 1st byte: ESC 2nd byte: ØF3H Default 3rd byte: Code of → --- 1CH 4th byte: Code of ← --- 1DH 5th byte: Code of ↑ --- 1EH 6th byte: Code of ↓ --- 1FH See "Arrow Key Function Chart" for details.	
ESC 0F4H	SET SCROLL KEY CODE	Does nothing.	Defines codes for SHIFT + arrow keys. (Command sequence) 1st byte: ESC 2nd byte: ØF4H Default 3rd byte: Code of SHIFT + → --- 8ØH 4th byte: Code of SHIFT + ← --- 8ØH 5th byte: Code of SHIFT + ↑ --- ØF8H 6th byte: Code of SHIFT + ↓ --- ØF9H See "Arrow Key Function Chart" for details.	

CODE	FUNCTION	SYSTEM MODE	MODE 0/1/2	MODE 3
ESC 0F5H	SET CTRL KEY CODE	Does nothing.	Defines codes for CTRL + arrow keys. (Command sequence) 1st byte: ESC 2nd byte: ØF4H Default 3rd byte: Code of CTRL + → --- ØFFH 4th byte: Code of CTRL + ← --- ØFEH 5th byte: Code of CTRL + ↑ --- ØFAH 6th byte: Code of CTRL + ↓ --- ØFBH See "Arrow Kay Function Chart" for details.	
ESC 0F6H	CLEAR KEY BUFFER	Clears the keyboard buffer (Clears entire data previously entered.)	Same as in system mode.	Same as in system mode.
ESC 0F7H	SET KEY SHIFT	Defines the key shift code. (Command sequence) 1st byte: ESC 2nd byte: ØF7H 3rd byte: Shift Code Shift code — Shift mode bit4 ON — NUM bit3 ON — HIRAGANA bit2 ON — KATAKANA bit1 ON — CAPS bitØ ON — NORMAL The function of the CTRL and SHIFT keys differs depending on the current keyboard state. When two or more bits are ON, the mode corresponding to the highest bit is taken.	Same as in system mode.	Same as in system mode.

CONOUT SPECIFICATIONS (1)

CODE	FUNCTION	MODE 4	MODE 5	REMARK
05H	ERASE END OF LINE	Same as in system mode.	Same as in system mode.	
07H	BELL	Same as in system mode.	Same as in system mode	
08H	BACK SPACE	Same as in system mode.	Same as in system mode.	
09H	TAB	Moves the cursor to the next tab position on the screen. This function moves the cursor to the beginning of the next line when no tab position is found on the current line. Tab position: Full width mode 8n + 1 Double width mode 16n + 1 (n = 1, 2, ...)	Same as in mode 4.	
0AH	LINE FEED	Moves the cursor down one line on the screen. This function causes the screen to scroll up one line when the cursor is on the bottom line of the screen.	Same as in mode 4.	
0BH	HOME	Same as in system mode.	Same as in system mode.	
0CH	CLEAR SCREEN & HOME	Same as in system mode.	Same as in system mode.	
0DH	CARRIAGE RETURN	Same as in system mode.	Same as in system mode.	

CONOUT SPECIFICATIONS (2)

CODE	FUNCTION	MODE 4	MODE 5	REMARKS
10H	SCREEN UP	Does nothing.	Does nothing.	
11H	SCREEN DOWN	Does nothing.	Does nothing.	
1AH	ERASE END OF SCREEN	Same as in system mode.	Same as in system mode.	
1BH	ESC	Same as in system mode.	Same as in system mode.	
1CH	CURSOR RIGHT	Moves the cursor one character position (1 column in full width mode or 2 columns in double width mode) to the right on the screen. When the cursor is in the last column on a line, this function moves the cursor to the first column of the next line. This function does nothing when the cursor is in the last column of the last line on the screen.	Same as in mode 4.	
1DH	CURSOR LEFT	Moves the cursor one character position (1 column in full width mode or 2 columns in double width mode) to the left on the screen. When the cursor is in the first column on a line, this function moves the cursor to the last column of the previous line. This function does nothing when the cursor is in the first column of the first line on the screen.	Same as in mode 4.	
1EH	CURSOR UP	Same as in system mode.	Same as in system mode.	
1FH	CURSOR DOWN	Same as in system mode.	Same as in system mode.	

CONOUT SPECIFICATIONS (3)

CODE	FUNCTION	MODE 4	MODE 5	REMARKS
ESC"%"	ACCESS CGROM DIRECTLY	Does nothing.	Does nothing.	(Command sequence) 1st byte: ESC 2nd byte: "%" 3rd byte: n ($\emptyset \leqq n \leqq 255$)
ESC"(" ESC")"	PASS THROUGH	Does nothing.	Does nothing.	
ESC"*"	CLEAR SCREEN	Same as in system mode.	Same as in system mode.	Same as ØCH.
ESC"0"	REVERSE ON	Displays the subsequent output characters in reverse video.	Does nothing.	Reverse video character size = 1 character size + underline area size The character size depends on the current character width.
ESC"1"	REVERSE OFF	Cancels the reverse video display function.	Does nothing.	
ESC"2"	CURSOR OFF	Same as in system mode.	Same as in system mode.	
ESC"3"	CURSOR ON	Same as in system mode.	Same as in system mode.	
ESC"4"	UNDERLINE ON	Displays characters with underlines.	Same as in mode 4.	
ESC"5"	UNDERLINE OFF	Cancels the underline display function.	Same as in mode 4.	
ESC"6"	HIGHLIGHT ON	Does nothing.	Does nothing.	
ESC"7"	HIGHLIGHT OFF	Does nothing.	Does nothing.	

CONOUT SPECIFICATIONS (4)

CODE		MODE 4	MODE 5	REMARKS
ESC"8"	BLINK ON	Does nothing.	Does nothing.	
ESC"9"	BLINK OFF	Does nothing.	Does nothing.	
ESC"<"	PUSH CURSOR POSITION	Does nothing.	Does nothing.	
ESC"="	SET CURSOR POSITION	Same as in system mode.	Same as in system mode.	
ESC">"	POP CURSOR POSITION	Does nothing.	Does nothing.	
ESC"C"	SET CHARACTER-SET TABLE	Does nothing.	Does nothing.	
ESC"L"	CHANGE CRT COLOR	Does nothing.	Does nothing.	Nothing is executed in old ASCII version (M25Ø3ØCA). In new ASCII version (M25Ø3ØCB), the data in the third parameter is displayed as is.
ESC"P"	SCREEN DUMP	Same as in system mode. (Only 2 or 3 lines (or entire screen) may be specified. See ESC + ØF8H and ESC + ØF9H descriptions for format.)	Same as in system mode.	
ESC"T"	ERASE END OF LINE	Same as in system mode.	Same as in system mode.	Same as ESC Ø5H.
ESC"Y"	ERASE END OF SCREEN	Same as in system mode.	Same as in system mode.	Same as ESC 1AH.
ESC 7BH	SECRET	Same as in system mode.	Same as in system mode.	
ESC 7CH	CHANGE V-RAM	Does nothing.	Does nothing.	
ESC 7DH	NON SECRET	Same as in system mode.	Same as in system mode.	

CONOUT SPECIFICATIONS (5)

CODE	FUNCTION	MODE 4	MODE 5	REMARKS
ESC 80H	1BYTE CODE TO 2BYTE CODE (KATAKANA)	Converts a JIS C622Ø code (katakana) into a shift JIS code and places it in the DE registers. (Command sequence) 1st byte: ESC 2nd byte: 8ØH 3rd byte: JIS C622Ø code (Return) DE registers: Shift JIS code See separate sheets for the character conversion chart.		Nothing is executed in old ASCII version (M25Ø3ØCA). In new ASCII version (M25Ø3ØCB), the data in the third parameter is displayed as is.
ESC 81H	1BYTE CODE TO 2BYTE CODE (HIRAGANA)	Converts a JIS C622Ø code (hiragana) into a shift JIS code and places it in the DE registers. (Command sequence) 1st byte: ESC 2nd byte: 81H 3rd byte: JIS C622Ø code (Return) DE registers: Shift JIS code See separate sheets for the character conversion chart.		Nothing is executed in old ASCII version (M25Ø3ØCA). In new ASCII version (M25Ø3ØCB), the data in the third parameter is displayed as is.
ESC 82H	2BYTE CODE TO 1BYTE CODE	Converts a shift JIS code into a JIS C622Ø code and places it in the DE registers. (Command sequence) 1st byte: ESC 2nd byte: 82H 3rd byte: Shift JIS (High) 4th byte: Shift JIS (Low) (Return) DE registers: JIS C622Ø code See separate sheets for the character conversion chart.		Nothing is executed in old ASCII version (M25Ø3ØCA). In new ASCII version (M25Ø3ØCB), the data in the third parameter is displayed as is.
ESC 83H	JIS C6226 CODE TO SHIFT JIS CODE	Converts a JIS C6226 code into a shift JIS code and places it in the DE registers. (Command sequence) 1st byte: ESC 2nd byte: 83H 3rd byte: JIS C6226 (High) 4th byte: JIS C6226 (Low)		

CONOUT SPECIFICATIONS (5)

CODE	FUNCTION	MODE 4	MODE 5	REMARKS
		(Return) DE registers: Shift JIS code See separate sheets for the character conversion table.		
ESC 84H	SHIFT JIS CODE TO JIS C6226 CODE	Converts a shift JIS code into the JIS C6226 code and places it in the DE registers. (Command sequence) 1st byte: ESC 2nd byte: 84H 3rd byte: Shift JIS (High) 4th byte: Shift JIS (Low) (Return) DE registers: JIS C6226 code See separate sheets for the character conversion chart.		

CODE	FUNCTION	MODE 4	MODE 5	REMARKS
ESC 90H	PARTIAL SCROLL UP	Does nothing.	Does nothing.	
ESC 91H	PARTIAL SCROLL DOWN	Does nothing.	Does nothing.	
ESC 92H	SCROLL RIGHT n CHARACTER	Scrolls the screen to the right by n columns. (Command sequence) 1st byte: ESC 2nd byte: 92H 3rd byte: Number of columns to be scrolled, n 1 ≦ n ≦ (maximum number of columns on the screen) Does nothing when an illegal number of columns are specified.	Does nothing.	Nothing is executed in old ASCII version (M25Ø3ØCA). In new ASCII version (M25Ø3ØCB), the data in the third parameter is displayed as is.
ESC 93H	SCROLL LEFT n CHARACTER	Scrolls the screen to the left by n columns. (Command sequence) 1st byte: ESC 2nd byte: 93H 3rd byte: Number of columns to scroll, n 1 ≦ n ≦ (maximum number of columns on the screen) Does nothing when an illegal number of columns is specified.	Does nothing.	Nothing is executed in old ASCII version (M25Ø3ØCA). In new ASCII version (M25Ø3ØCB), the data in the third parameter is displayed as is.

CONOUT SPECIFICATIONS (6)

CODE	FUNCTION	MODE 4	MODE 5	REMARKS
ESC 94H	SET SCROLL STEP	Does nothing. (The number of lines to be scrolled may be specified in the same way as for screen 5. This value is effective only when screen 5 is selected. On screen 4, the number of lines to scroll is always 1. Actual scrolling takes place when ESC + 96H or ESC + 97H is executed.	Specifies the number of lines to be scrolled. (Command sequence) 1st byte: ESC 2nd byte: 94H 3rd byte: Number of lines, n ($1 \leqq n \leqq 15$) Does nothing when an illegal number of columns is specified.	
ESC 95H	SET SCROLL MODE	Does nothing.	Does nothing.	
ESC 96H	SCROLL UP n LINE	Moves up the screen on which the cursor rests by one line. The cursor is held in the original position on the screen.	Moves up the screen on which the cursor rests by n lines. The cursor is held in the original position on the screen. The value of n equals the value specified in ESC + 94H. The default value is 1.	
ESC 97H	SCROLL DOWN n LINE	Moves down the screen on which the cursor rests by one line. The cursor is held in the original position on the screen.	Moves down the screen on which the cursor rests by n lines. The cursor is held in the original position on the screen. The value of n equals the value specified in ESC + 94H. The default value is 1.	

CODE	FUNCTION	MODE 4	MODE 5	REMARKS
ESC 0A0H	INS LED ON	Same as in system mode.	Same as in system mode.	
ESC 0A1H	INS LED OFF	Same as in system mode.	Same as in system mode.	
ESC 0A2H	CAPS LOCK LED ON	Same as in system mode.	Same as in system mode.	
ESC 0A3H	CAPS LOCK LED OFF	Same as in system mode.	Same as in system mode.	
ESC 0A4H	NUM LED ON	Same as in system mode.	Same as in system mode.	
ESC 0A5H	NUM LED OFF	Same as in system mode.	Same as in system mode.	
ESC 0B0H	FUNCTION KEY CHECK MODE ON	Same as in system mode.	Same as in system mode.	
ESC 0B1H	FUNCTION KEY CHECK MODE OFF	Same as in system mode.	Same as in system mode.	
ESC 0C0H	CHANGE KANJI MODE	Switches the screen mode between kanji and non-kanji. (Command sequence) 1st byte: ESC 2nd byte: ØCØH 3rd byte: Mode non-zero = kanji mode zero = non-kanji mode If the mode is switched from non-kanji to kanji, the screen is initialized in the screen mode 4 in which 6Ø half-size character images (3Ø kanji images) can be displayed in a line and in which the screen is ready for phrase translation. When the mode is switched from kanji to non-kanji, screen mode Ø, VS1=25, VS2=23, VS1, block blink cursor, and tracking mode are selected.		
ESC 0C0H	SCREEN ALL CLEAR AND MASKING GUIDE	Clears the entire screen and masks all system areas.	Same as in mode 4.	

CONOUT SPECIFICATIONS (8)

CODE	FUNCTION	MODE 4	MODE 5	REMARKS
ESC 0C2H	HORIZONTAL DOT LINE WRITE	Draws a horizontal dot line on the LCD screen. (Command sequence) 1st byte: ESC 2nd byte: ØC2H 3rd byte: Starting point (vertical) n1 4th byte: Starting point (horizontal) <H> n2 5th byte: Starting point (horizontal) <L> 6th byte: Length <H> n3 7th byte: Length <L> Ø ≦ n1 ≦ 63 Ø ≦ n2 ≦ 479 1 ≦ n3 ≦ 48Ø This function does nothing when the line goes beyond the screen.	Same as in mode 4.	Nothing is executed in old ASCII version (M25Ø3ØCA). In new ASCII version (M25Ø3ØCB), the data specified in the third and subsequent parameters is displayed as is.
ESC 0C3H	HORIZONTAL DOT LINE ERASE	Draws a horizontal space dot line on the LCD screen. (Command sequence) 1st byte: ESC 2nd byte: ØC3H 3rd byte: Starting point (vertical) n1 4th byte: Starting point (horizontal) <H> n2 5th byte: Starting point (horizontal) <L> 6th byte: Length <H> n3 7th byte: Length <L> Ø ≦ n1 ≦ 63 Ø ≦ n2 ≦ 479 1 ≦ n3 ≦ 48Ø	Same as in mode 4.	Nothing is executed in old ASCII version (M25Ø3ØCA). In new ASCII version (M25Ø3ØCB), the data specified in the third and subsequent parameters is displayed as is.

CODE	FUNCTION	MODE 4	MODE 5	REMARKS
		This function does nothing when the line goes beyond the screen.		
ESC OC4H	VERTICAL DOT LINE WRITE	Draws a vertical dot line on the LCD screen. (Command sequence) 1st byte: ESC 2nd byte: ØC4H 3rd byte: Starting point (vertical) n1 4th byte: Starting point (horizontal) <H> n2 5th byte: Starting point (horizontal) <L> 6th byte: Length <H> n3 $Ø \leqq n1 \leqq 63$ $Ø \leqq n2 \leqq 479$ $1 \leqq n3 \leqq 64$ This function does nothing when the line goes beyond the screen.	Same as in mode 4.	Nothing is executed in old ASCII version (M25Ø3ØCA). In new ASCII version (M25Ø3ØCB), the data specified in the third and subsequent parameters is displayed as is.

CONOUT SPECIFICATIONS (9)

CODE	FUNCTION	MODE 4	MODE 5	REMARKS
ESC OC5H	VERTICAL DOT LINE ERASE	Draws a space dot line in the vertical direction on the LCD screen. (Command sequence) 1st byte: ESC 2nd byte: ØC5H 3rd byte: Starting point (vertical) n1 4th byte: Starting point (horizontal) <H> n2 5th byte: Starting point (horizontal) <L> 6th byte: Length <H> n3 7th byte: Length <L> $\emptyset \leqq n1 \leqq 63$ $\emptyset \leqq n2 \leqq 479$ $1 \leqq n3 \leqq 480$ This function does nothing when the line goes beyond the screen.	Same as in mode 4.	Nothing is executed in old ASCII version (M25Ø3ØCA). In new ASCII version (M25Ø3ØCB), the data specified in the thrid and subsequent parameters is displayed as is.

CODE	FUNCTION	MODE 4	MODE 5	REMARKS
ESC 0C6H	DOT LINE WRITE	Draws a line of user-specified dot pattern on the LCD screen. (Command sequence) 1st byte: ESC 2nd byte: ØC6H 3rd byte: Starting position (horizontal) <H> m1 4th byte: Starting position (horizontal) <L> 5th byte: Starting position (vertical) <H> m2 6th byte: Starting position (vertical) <L> 7th byte: Ending position (horizontal) <H> n1 8th byte: Ending position (horizontal) <L> 9th byte: Ending position (vertical) <H> 1Øth byte: Ending position (vertical) <L> 11th bute: Mask pattern 1 12th byte: Mask pattern 2 13th byte: Operation where |m1-n1| < 16383 |m2-n2| < 16383 The pattern must be specified in bit image in 16 bits from mask pattern 1, bit 7 through mask pattern 2, bit Ø. Line segments are masked sequentially by this mask pattern in the mode specified by operation. The dot coordinates of a slanted line are automatically calculated by the function. (Operation) Operation specifies the mode in which the dot coordinates corresponding to the 1 bits of the (16) mask pattern are to be masked. The operation codes are: 01H = Off 02H = On 03H = Complement See separate sheets for dot coordinates.		

CODE	FUNCTION	MODE 4	MODE 5	REMARKS
ESC 0C7H	PSET/PRESET	Sets and resets the specified point on the LCD screen. (Command sequence) 1st byte: ESC 2nd byte: ØC7H 3rd byte: Function code 4th byte: Plot position (vertical) n1 5th byte: Plot position (horizontal) < H > n2 6th byte: Plot position (horizontal) < L > Ø ≦ n1 ≦ 63, Ø ≦ n2 ≦ 479 Function code: 1 = PSET (ON) Ø = PRESET (OFF)	Same as in mode 4.	
ESC 0C8H	CHARACTER SIZE WIDE	Sets the screen character display size to double width.	Same as in mode 4.	
ESC 0C9H	CHARACTER SIZE NARROW	Sets the screen character display size to full width.	Same as in mode 4.	
ESC 0CBH	SET KEISEN MODE	Sets and resets the ruler line mode for the ruler line data. (Command sequence) 1st byte: ESC 2nd byte: ØCBH 3rd byte: nonzero = ruler line mode on. zero = ruler line mode off. The ruler line data includes the following: (SHIFT JIS CODE) 83F9H - 83FCH	Same as in mode 4.	

CONOUT SPECIFICATIONS (1Ø)

CODE	FUNCTION	MODE 4	MODE 5	REMARKS
		849FH - 84AEH 84B1H - 84BBH 84C3H - 84F4H F74ØH - F747H		

CODE	FUNCTION	MODE 4	MODE 5	REMARKS
ESC OCCH	CONTROL GUIDE DISPLAY SET/RESET	Turns on or off display on the system area. (Command sequence) 1st byte: ESC 2nd byte: ØCCH 3rd byte: BIT 7 ... Shift mode (1-6 coloumns) BIT 6 ... Input data display (15-53 columns) BIT 5 ... Entry subguide (54-6Ø columns) BIT 4 ... Convert mode guide (11-12 columns) BIT 3 ... Guide line Data is masked if the corresponding bit is on, and displayed if the bit is off. More than one mode can be specified.		
ESC OCDH	CLEAR GUIDE	Clears vertical dot lines 46 through 64 (the area below the guide line).	Does nothing.	
ESC OCEH	CHANGE CONVERT MODE	Switches between the convert and nonconvert modes. (Command sequence) 1st byte: ESC 2nd byte: ØCEH 3rd byte: Change information BIT Ø ... ON: Convert mode OFF: Nonconvert mode BIT 6 ... ON: Enables convert mode switching from the keyboard. BIT 7 ... ON: Disables convert mode switching from the keyboard. Bit 7 takes precedence over bit 6 when both bits are on. The keyboard buffer is cleared each time the mode is switched from convert to nonconvert and vice versa. Actual switching takes place when CONIN or CONST is executed. The guide line display is also updated at this time.		

CODE	FUNCTION	MODE 4	MODE 5	REMARKS
ESC 0D0H	DISPLAY MODE SET	Switches the screen mode between normal (screen 4) and zoom (screen 5). (Command sequence) 1st byte: ESC 2nd byte: ØDØH 3rd byte: Mode Ø4H: Normal mode Ø5H: Zoom mode 4th byte: Number of columns 1-6Ø in normal mode 1-1ØØ in zoom mode Switching into the same mode is regarded as changing the number of columns and the cursor is placed in the home position.		
ESC 0D1H	SELECT DISPLAY SCREEN	Does nothing.	Does nothing.	
ESC 0D2H	DIRECT DISPLAY OF PHYSICAL SCREEN	Displays a character in the specified position on the real screen. (Command sequence) 1st byte: ESC 2nd byte: ØD2H 3rd byte: Row position (1-3 lines) 4th byte: Column position (1-6Ø columns) 5th byte: Attribute zero: Full width Nonzero: Double width 6th byte: Display specification zero: User area Nonzero: Guide area 7th byte: Character code HIGH 8th byte: Character code LOW When the 7th byte is a code from 2ØH to 7FH or from ØAØH to ØDFH, this function regards the code as consisting only of one byte and ignores the 8th byte. When the 7th byte is a code from ØØH to 1FH, the function takes it as an error and does nothing. The display position may be set to any location on the screen with the line and column numbers.		

CONOUT SPECIFICATIONS (12)

CODE	FUNCTION	MODE 4	MODE 5	REMARKS
		When the 6th byte indicates the user area, this function displays the character in 16×22 dot matrix according to the specified attributes. When the 6th byte indicates the guide area, the function displays the character in 16×18 dot matrix ignoring the attribute. When the 3rd line is specified as the user area, it is treated as the guide line.		
ESC 0D3H	SELECT FUNCTION KEY DISPLAY	Does nothing.	Does nothing.	
ESC 0D4H	LOCATE TOP OF SCREEN	Does nothing.	Does nothing.	
ESC 0D5H	LOCATE END OF SCREEN	Does nothing.	Does nothing.	

CODE	FUNCTION	MODE 4	MODE 5	REMARKS
ESC 0D6H	SELECT CURSOR KIND	Does nothing. (Set to the nonblink underline cursor.)	Does nothing. (Set to the 4×4 dot blinking block cursor.)	
ESC 0D7H	FIND CURSOR	Does nothing.	Does nothing.	
ESC 0E0H	SET DOWN LOAD CHARACTER	Does nothing.	Does nothing.	
ESC 0F0H	KEYBOARD REPEAT ON/OFF	Controls the keyboard repeat function (receiving key code repeatedly while a key is held). (Command sequence) 1st byte: ESC 2nd byte: ØFØH 3rd byte: Ø (repeat off) 1 (repeat on) The default is repeat on.	Same as in mode 4.	
ESC 0F1H	SET KEYBOARD REPEAT START TIME	Specifies the keyboard repeat start time (interval between the time the first data is entered and the time the second data is taken when the key is held). (Command sequence) 1st byte: ESC 2nd byte: ØF1H 3rd byte: n (n/64 SEC) ($1 \leqq n \leqq 127$) The default is approx. 656 ms.	Same as in mode 4.	
ESC 0F2H	SET KEYBOARD REPEAT INTERVAL TIME	Specifies the keyboard repeat interval time. (Command sequence) 1st byte: ESC 2nd byte: ØF2H 3rd byte: n (n/256 SEC) ($1 \leqq n \leqq 127$) The default is approx. 7Ø ms.	Same as in mode 4.	

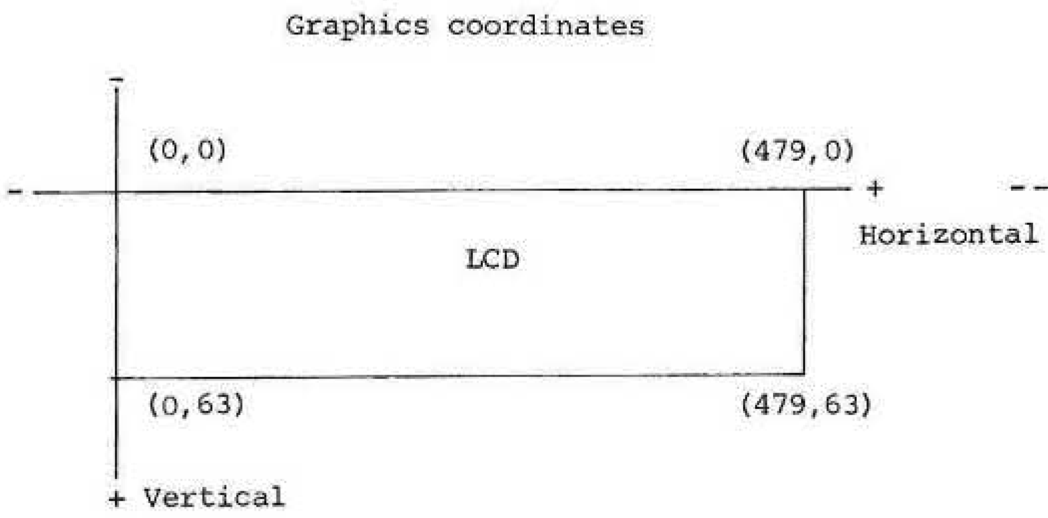
CODE	FUNCTION	MODE 4	MODE 5	REMARKS
ESC 0F3H	SET ARROW KEY CODE	Defines the arrow key codes. (Command sequence) 1st byte: ESC 2nd byte: ØF3H Default 3rd byte: Code of → --- 1CH 4th byte: Code of ← --- 1DH 5th byte: Code of ↑ --- 1EH 6th byte: Code of ↓ --- 1FH See "Arrow Key Function Chart" for details.		See "Arrow Key Function Chart".
ESC 0F4H	SET SCROLL KEY CODE	Defines codes for SHIFT + arrow key combinations. (Command sequence) 1st byte: ESC 2nd byte: ØF4H Default 3rd byte: Code of SHIFT + → --- 8ØH 4th byte: Code of SHIFT + ← --- 8ØH 5th byte: Code of SHIFT + ↑ --- ØF8H 6th byte: Code of SHIFT + ↓ --- ØF9H See "Arrow Key Function Chart" for details.		See "Arrow Key Function Chart".
ESC 0F5H	SET CTRL KEY CODE	Defines codes for CTRL + arrow key combinations. (Command sequence) 1st byte: ESC 2nd byte: ØF4H Default 3rd byte: Code of CTRL + → --- ØFFH 4th byte: Code of CTRL + ← --- ØFEH 5th byte: Code of CTRL + ↑ --- ØFAH 6th byte: Code of CTRL + ↓ --- ØFBH See "Arrow Key Function Chart" for details.		See "Arrow Key Function Chart".
ESC 0F6H	CLEAR KEY BUFFER	Same as in system mode.	Same as in system mode.	
ESC 0F7H	SET KEY SHIFT	Same as in system mode.	Same as in system mode.	

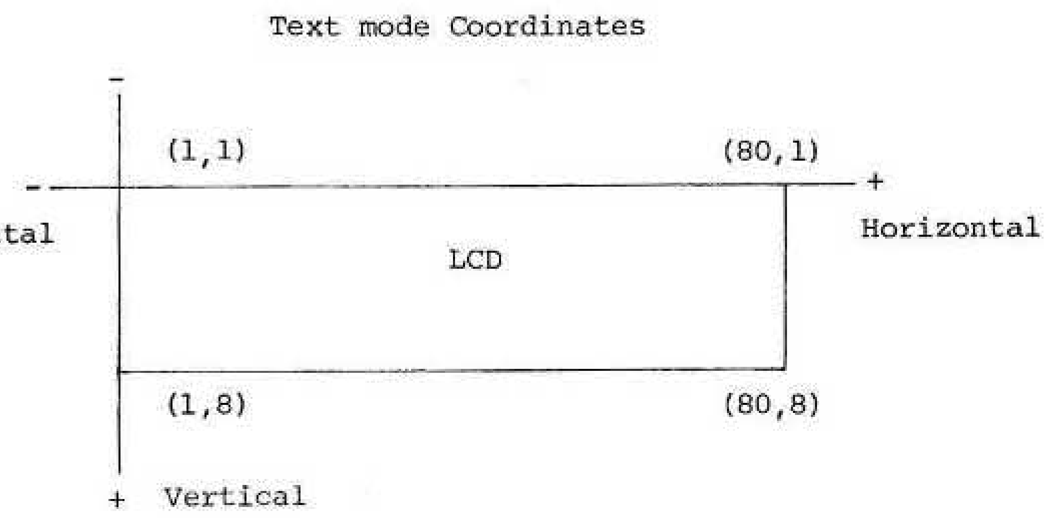
CONOUT SPECIFICATIONS (15)

CODE	FUNCTION	MODE 4	MODE 5	REMARKS
ESC 0F8H	SCREEN DUMP OF 44 DOT-LINE	Takes a dump of 1 to 44 vertical dot lines (not including the guide line) on the LCD screen.	This function only accepts the sequence but carries out no actual dump. (Actual dump is initiated when the user later sets the screen to mode 4 with ESC + ØDØH.)	
ESC 0F9H	SCREEN DUMP OF 64 DOT-LINE	Takes a dump of 1 to 64 vertical dot lines (including the guide line) on the LCD screen.	This function only accepts the sequence but carries out no actual dump. (Actual dump is initiated when the user later sets the screen to mode 4 with ESC + ØDØH.)	

Note: Starting and ending positions in the ESC Ø6CH (Dot Line Write sequence)

ESC+Ø6CH draws a line across the specified two points assuming that the LCD screen exists at the coordinates shown below. Values are taken to be negative when MSB is 1. Negative values are represented in two's complement form.





Key Function Chart

rrow keys (including the shift keys) may be set to any codes the above listed ESC sequences. Some special codes are to control the screen directly. The codes and functions are d below.

CODE	FUNCTION	DEFAULT KEY
00H . . 1BH	See the CONOUT Specifications	
1CH	CURSOR RIGHT	→
1DH	CURSOR LEFT	←
1EH	CURSOR UP	↑
1FH	CURSOR DOWN	↓
20H . . 7FH	See the CONOUT Specifications	
80H	Does nothing.	SHIFT/ → SHIFT/ ←
81H . . F7H	See the CONOUT Specifications	
F8H	Scroll Up One Line	SHIFT/ ↑
F9H	Scroll Down One Line	SHIFT/ ↓
FAH	Page Up	CTRL/ ↑
FBH	Page Down	CTRL/ ↓
FCH	TOP OF SCREEN	
FDH	BOTTOM OF SCREEN	
FEH	Switch To VS1	CTRL/ ←
FFH	Switch To VS2	CTRL/ →

are disabled when they are set to 80H. When a key is set to f the codes F8H through FFH, it is disabled and the screen e controlled directly by the user.

C Sequence Parameter Table

e table below lists the ESC sequences for which the MAPLE does thing and discards any parameters.

SC sequences and the number of parameters that are ignored)

NUMBER	CODE	KANA MODE	KANJI MODE	REMARKS
1	ESC "%"	-	1	Access CG ROM directly
2	ESC "C"	1	1	Set character
3	ESC "L"	2	2	Change CRT Color In the new ASCII version (M25Ø3ØCB) kana mode, the parameters are displayed as they are (garbage data).
4	ESC 80H	1	-	Code conversion In the new ASCII version (M25Ø3ØCB) kana mode, the parameters are displayed as they are (garbage data).
5	ESC 81H	1	-	Code conversion In the new ASCII version (M25Ø3ØCB) kana mode, the parameters are displayed as they are (garbage data).
6	ESC 82H	2	-	Code conversion In the new ASCII version (M25Ø3ØCB) kana mode, the parameters are displayed as they are (garbage data).
7	ESC 83H	2	-	JIS C6226 → SHIFT JIS
8	ESC 84H	2	-	SHIFT JIS → JIS C6226
9	ESC 90H	-	2	Partial Scroll Up
10	ESC 91H	-	2	Partial Scroll Down
11	ESC 92H	1	-	Scroll Right In the new ASCII version (M25Ø3ØCB) kana mode, the parameters are displayed as they are (garbage data).

UMBER	CODE	KANA MODE	KANJI MODE	REMARKS
12	ESC 93H	1	-	Scroll Left In the new ASCII version (M25Ø3ØCB) kana mode, the parameters are displayed as they are (garbage data).
13	ESC 95H	-	1	Set Scroll Mode
14	ESC 0C2H	5	-	Horizontal Line Write In the new ASCII version (M25Ø3ØCB) kana mode, the parameters are displayed as they are (garbage data).
15	ESC 0C3H	5	-	Horizontal Line Erase In the new ASCII version (M25Ø3ØCB) kana mode, the parameters are displayed as they are (garbage data).
16	ESC 0C4H	4	-	Vertical Line Write In the new ASCII version (M25Ø3ØCB) kana mode, the parameters are displayed as they are (garbage data).
17	ESC 0C5H	4	-	Vertical Line Erase In the new ASCII version (M25Ø3ØCB) kana mode, the parameters are displayed as they are (garbage data).
18	ESC 0CBH	1	-	Ruler Line Mode On/Off
19	ESC 0CCH	1	-	Set/Reset Guide Display
20	ESC 0CEH	1	-	Change Convert Mode
21	ESC 0D1H	-	1	Switch between VS1 and VS2
22	ESC 0D3H	-	1	Display Function Key
23	ESC 0D6H	-	1	Cursor Type
24	ESC 0E0H	-	9	User Defined Character

Note: "-" indicates that the MAPLE takes some action.

Chapter 7 System Functions

The MAPLE provides the following six system functions in addition to the standard CP/M functions:

1) Password
2) Auto Start String
3) Menu
4) Resident
5) System Display
6) Auto Power Off

This chapter describes the six system functions.

.1 Password

he operation of and specifications for the Password unction are described in "OS Specifications". This ection describes how to set or cancel a password in n application program. The contents of the password pecified in the following work area is held intact ntil the next system initialization:

- PASFLG: Overseas version = ØFØ1DH
  Japanese-language version = ØED1DH
  This flag indicates whether a password is defined or not.
  = ØØH: No password defined.
  ≠ ØØH: Password defined.
- PASWRD: Overseas version = ØFØ1EH
  Japanese-language version = ØED1EH
  This 8-byte area is loaded with the password in the complemented form.

lote: When the password is canceled with the PASFLG set to 00H, all of the eight bytes starting at the PASWRD must also be padded with "?" marks. This is because MTOS will copy this password onto tape.

7.2 Auto Start String

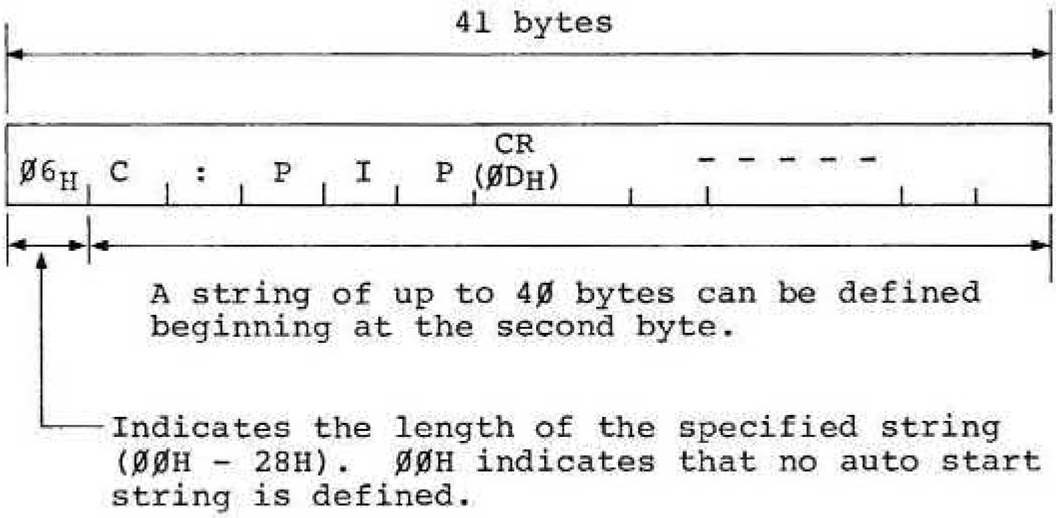
The Auto Start String function loads a predefined auto start string into the key buffer when a warm boot is initiated by a power on and processes it as if it were entered from the keyboard. This function is useful for users who wish to run a specific program every time they start their system or those who want to use the MAPLE as a turn-key system.

This section shows how to define and cancel an auto start string in an application program. Refer to "OS specifications" for the operation of and specifications for the Auto Start String function.

- AUTOSTRT: Overseas version = 0F3D6H

  Japanese-language version = 0F14BH

  The auto start string is loaded in the buffer area at the above location in the following format:



n auto start string may consist of up to 40 bytes ncluding control codes if the string is to be defined irectly in the work area. The length of the actual tring, however, must be shorter than 40 bytes if control odes are included because a control code is displayed y two characters on the system display.

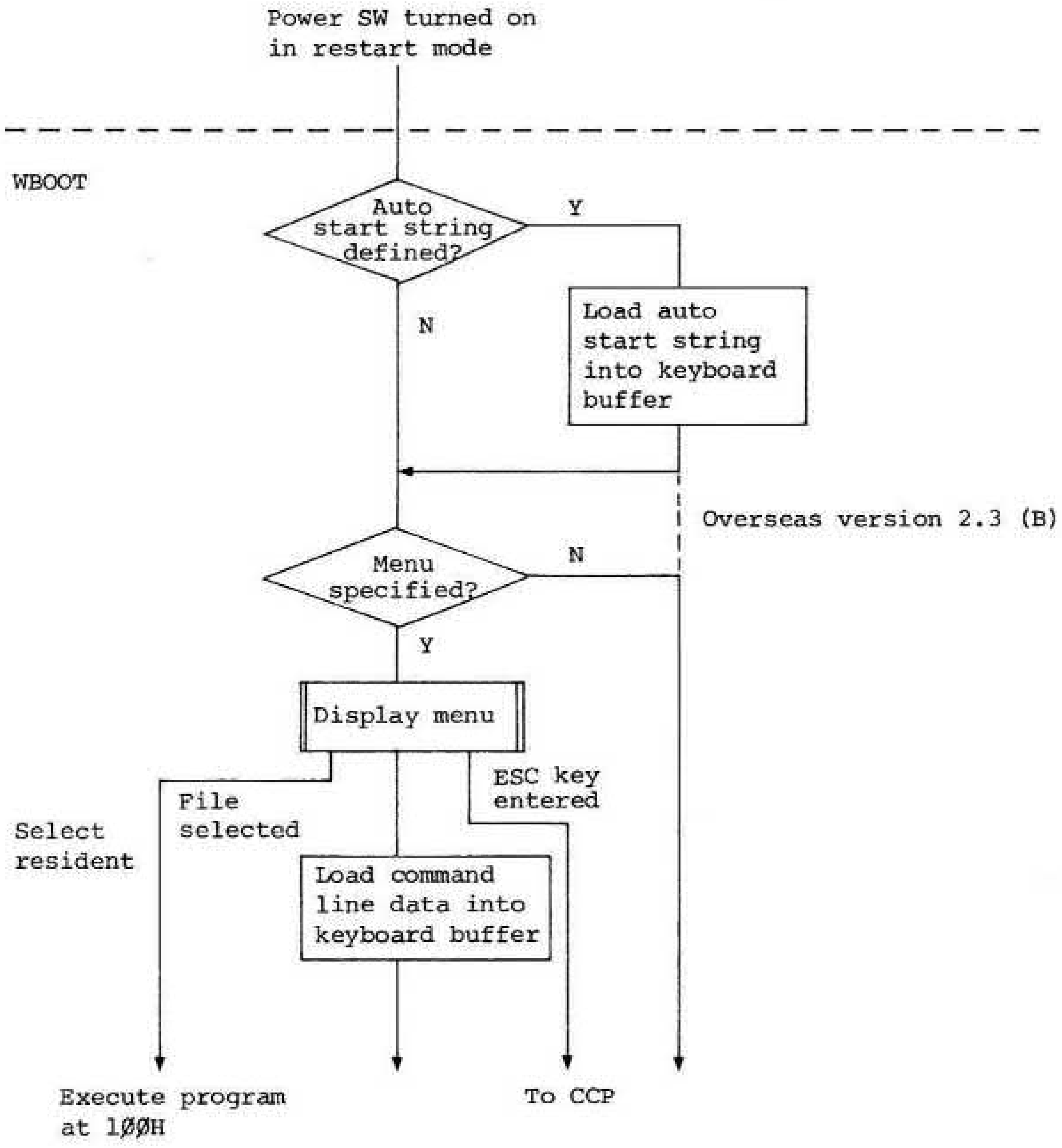
he contents of in the work area is cleared during ystem initialization.

Auto start string and menu display

n Overseas Version 1.0 and Japanese-language Version, he auto start string is treated in the same way as eyed in data on the menu screen command line. This ecessitates the user to be aware of where the auto start tring will work (on the menu screen or as a CCP ommand).

n Overseas Version 2.3 (B), on the other hand, if an uto start string is stored in the keyboard buffer, it lways works as a CCP command, whether it is displayed n the menu screen or not. The user, therefore, need nly define the auto start string as a CCP command.

The figure below shows how WBOOT processes the auto start string.



.3 Menu

his section explains how to define and cancel a menu in n application program. Refer to "OS Specifications" or the operation of and specifications for the menu unction.

MENUFG: Overseas version = 0F02AH

Japanese-language version = 0ED2AH

This flag indicates whether a menu is to be displayed during WBOOT processing.

= 00H: Menu displayed.

≠ 00H: No menu displayed.

MENUFG is initialized to 00H.

MENUDRV: Overseas version = 0F02BH

Japanese-language version = 0ED2BH

The 8-byte area starting at the above address is loaded with the ASCII codes corresponding to the drives of which the directory is to be loaded. Lowercase letters are converted to uppercase letters. The MAPLE supports drives A through H (A through I for Overseas version 2.3 (B)). Specify letters from A through H or I. If a letter is specified more than once, the MAPLE will display the directory of the corresponding drive the number of times equal to the number of occurrence of the letter. Any letters other than A through H (or I) are ignored. This area is initialized to "CBA_____" (ICBA_____" for Overseas Version 2.2 (B)).

- FTYPETBL: Overseas version = 0F036H

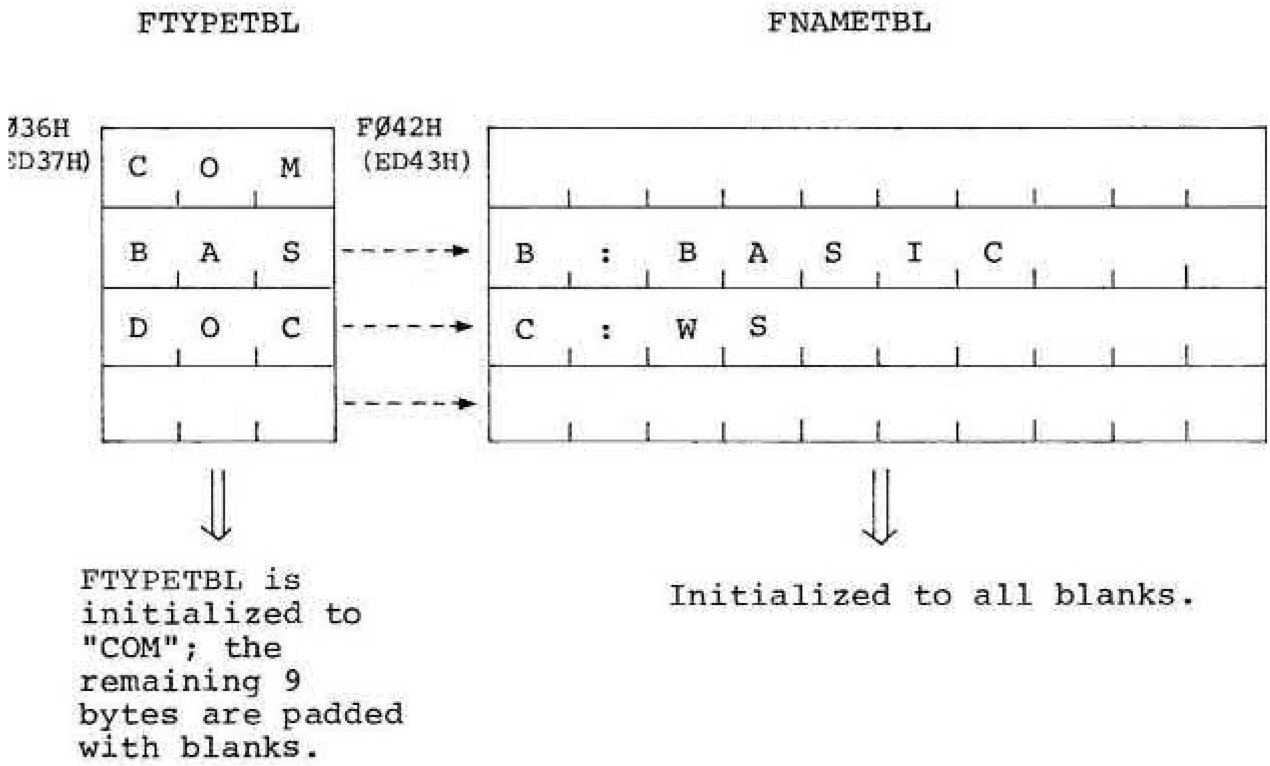
  Japanese-language version = 0ED37H

  The 12-byte area starting at the above address is loaded with the file types of the files that are to be displayed in the menu. Specify up to four 3-character file types. A file type of three blanks is treated as undefined.

- FNAMETBL: Overseas version = 0F042H

  Japanese-language version = 0ED43H

  The 40-byte area starting at the above address is loaded with the file names (10 characters including the drive name) of the COM files that are to be displayed in the menu. Specify up to four file names.



n the above example, the menu displays files which have
 file type of either ".COM," ".BAS," or ".DOC." When
he user select a file having a file type of ".BAS" with
ursor keys, the message "B:BASIC___" is displayed at
he beginning of the command line, followed by the name
f the selected file. The menu function then waits for
ey entry. When a file with a file type of ".DOC" is
elected, the message "C:WS______" is displayed at the
eginning of the command line. When a file with a file
ype of ".COM" is selected, no data is taken from
NAMETBL and only the specified file name is displayed
n the command line starting at its beginning.

The contents of the above work areas can be set by menu file specification in System Display. The work areas are initialized during each system initialization and their contents are preserved until the next system initialization.

Only the BS edit function is effective on the command line.

.4 Running Resident Programs

f the address MTPAFG is loaded with a value other than ero, the comment "(resident)" is displayed following e first file (the file on the upper left position on e first page) of the menu.
en this file is selected from the menu, the OS will load transient program but transfers control directly to e program already in memory at address 100H. This nction is used to eliminate the time required to load program from a disk drive. The resident function is abled only when the menu is displayed. BASIC takes dvantage of this function.

MTPAFG: Overseas version = 0F035H

Japanese-language version = 0ED36H

Indicates whether the resident function is to be enabled during menu processing.

= 00H: Resident function disabled.

≠ 00H: Resident function enabled.

MTPAFG is initialized to 00H.

If the program to be executed at address 100H is programmed to set this work area to zero at its beginning, it displays the contents of the

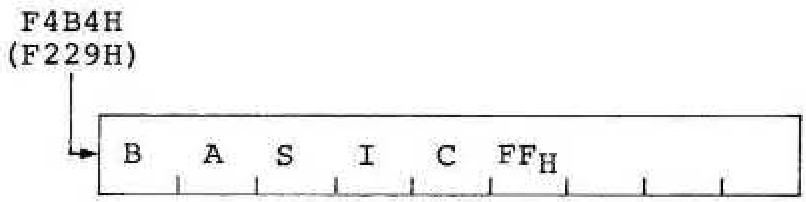
MTPAM at the beginning of the menu when it terminates execution with the WBOOT routine. If the contents of the MTPAM is selected in the menu, the program at address 100H starts execution immediately.

This work area is automatically cleared to zero by the OS when the menu function is exited.

- MTPNM: Overseas version = 0F0B4H

  Japanese-language version = 0F229H

  This 9-byte area is loaded with the message to be displayed at the beginning of the menu. The message must be terminated by an 0FFH. The user can specify not longer than 8 characters. This area must always be filled when MTPAFG is set to 00H. BASIC assumes the following message in MTPANM:



The following message will then be displayed at the beginning of the menu:

```
BASIC  (resident)
```

.5 System Display

efer to "OS Specifications" for the use of the system isplay function.

s explained in Chapter 5, "keyboard," this function is nvoked as a subroutine from a BIOS keyboard routine ien the HELP key is pressed while holding down the TRL key. This means that if the application program xecutes neither BDOS nor BIOS keyboard routines CONST, CONIN, etc.), this function will not be started henever the CTRL/HELP keys are pressed.

he system display function provides the following ubfunctions:

) Password processing

) Alarm/wake processing

) Auto start string processing

) Menu processing

) MCT processing

) Manual MCT processing

7.5.1 Password

The password system display function defines, cancels, or displays a password using the work areas described in 7.1.

7.5.2 Alarm/Wake

The alarm/wake system display function sets, resets, and displays the status of the alarm/wake function using the TIMDAT internal BIOS function. This system display function, however, has the following restrictions compared with the alarm/wake BIOS function:

(1) The time can be set only in minutes (the second field is set to 0). (The BIOS function allows the time to be set in 10-second units.)

(2) The day of the week is not supported (the day of the week field in the time descriptor is set to 0FFH). Only the month, the day, and the time are supported.

(3) Only WAKE1 is supported (specifying WAKE2 is invalid).

or further information, see Chapter4, "BIOS Functions" nd Chapter 8 "Alarm/Wake Function."

.5.3 Auto Start String

he auto start string function defines, cancels, or isplays an auto start string using the work areas escribed in 7.2.

.5.4 Menu

he menu system display function defines, cancels, or isplays a menu using the work areas described in 7.3.

.5.5 MCT

he MCT system display function sets the following two odes:

- Stop/Nonstop mode
- Verify mode

1) Stop/nonstop mode

The MCT system display function specifies whether tape blocks are to be fed in the stop or nonstop mode when writing a file onto tape using the work areas described below. The mode used for writing a file on MCT tape is used when the file is read from the MCT tape (the mode, however, can be changed by rewriting the work areas).

See Chapter 14, "MTOS/MIOS Operations" for details on the stop/nonstop modes and related work areas.

- DFTATR: Overseas version = 0F2E0H

  Japanese-language version = 0F01DH

- TACATR: Overseas version = 0F78FH

  Japanese-language version = 0F70CH

  In both work areas:

  A 1 in bit 7 specifies the stop mode.

  A 0 in bit 7 specifies the nonstop mode.

  DFTATR is initialized to '1100010B'.

  Both work areas must be updated simultaneously when the mode is to be changed.

2) Verify mode

The MCT system display function also specifies whether the contents of the tape are to be verified after a write operation. When verify mode is specified, after closing the written file, the MTOS/MIOS rewinds the tape, reads the file blocks on the tape, and compares the CRC bytes with those in memory for each tape block. It does not verify data itself.

See Chapter 14, "MTOS/MIOS Operations" for details on the verify mode.

- VERFDFLT: Overseas version = 0F07BH
  Japanese-language version = 0F036H
- VERFFG: Overseas version = 0F07CH
  Japanese-language version = 0F737H
  The use of both work areas are the same:
  = 0FFH turns on the verify mode.
  ≠ 0FFH: turns off the verify mode.
  These work areas are initialized to 00H. They must be updated simultaneously when the mode is to be changed.

7.5.6 Manual MCT Operation

The system display function executes as follows when the user controls MCT operations with PF keys:

1) PF1 (FF)

Executes the internal MIOS function 06H (FF).

2) PF2 (PLAY)

Executes the following functions sequentially:

i) MIOS function 0BH (HEAD ON).

ii) MIOS function 04H (PLAY).

iii) 7805 command 72H (with 10000000B as parameter) to turn on the speaker.

3) PF3 (STOP)

Executes the following functions sequentially:

i) 7805 command 72H (with 00000000B as parameter) to turn off the speaker.

ii) MIOS function 03H (STOP).

iii) 7805 command 0CH (HEAD OFF)

:) PF4 (REWIND)

:xecutes the MIOS function 08H (REWIND).

;) PF5 (RESET COUNTER)

:xecutes the MIOS function 02H to reset the tape counter
:o 0.

;) PF6 (REMOVE)

:xecutes the MTOS function 252 (REMOVE).

') PF7 (MOUNT)

:xecutes the MTOS function 253 (MOUNT).

:) PF8 (DIRINIT)

:xecutes the MTOS function 255 (MAKDIR).

') PF9 (ERASE)

:xecutes the MIOS function 15H (ERASE) to erase the
.ape.

are must be taken with the following when operating the CT manually:

) No manual operation on the MCT is allowed when a file on the MCT is open. Whether a file is opened or not can be identified by checking the following work area:

- OPNMOD: Overseas version = 0F361H

  Japanese-language version = 0F0A8H

  = 00H: No file is open.

  = 01H: A file is opened in the read mode.

  = 02H: A file is opened in the write mode.

) Operations other than remove are not allowed when a MCT is mounted but no files are opened. This is because any operation other than remove will affect the counter value.

) Any operation is allowed when no MCT is mounted.

Whether the MCT is in the mount or remove state can be identified by checking the following work area:

- TAPMOD: Overseas version = ØF2DDH

  Japanese-language version = ØFØ1AH

  = ØØH: Remove state

  = Ø1H: Mount state

While the Z8Ø proceeds to the next instruction immediately after calling an MIOS function, the slave CPU continues to execute the MIOS function after it is invoked. Accordingly, the calling program, after calling an MIOS function, must monitor the state of the MCT and terminate the MIOS function at a necessary point. Terminating an MIOS function can also be done using an MIOS function (e.g., a function equivalent to PF3 (STOP)).

e Chapter 14, "MTOS/MIOS Operations" for details on the 'OS and MIOS functions and Chapter 13 "Slave CPU ·erations" for detailed discussion of the slave CPU nctions.

7 Other Information Displayed by System Display Function

lock on first line

system display function reads and displays the present time g the TIMDAT BIOS function.

isk size on third line

RAM disk size in bytes is stored in the following area in binary format:

IZERAM: Overseas version = 0F6A8H

Japanese-language version = 0F42BH

ser BIOS size on fourth line

user BIOS size in 256-byte units is stored in the following area in binary format:

ERBIOS: Overseas version = 0F00BH

Japanese-language version = 0ED0BH

ape counter value on fourth line

system display function reads the tape counter value g the MIOS function 01H (REDCT).

.6 Auto Power Off

ɔ save power, the MAPLE automatically turns its power :f in the continue mode if it receives no data from the ɜyboard within a predetermined time while it waits for ɜyed-in data with the CONIN BIOS function. When its ɔwer switch is turned off and back on again, the MAPLE ɜsumes its operation at the point where it was waiting ɔr keyed-in data. This feature is called the auto ɔwer off function.

ıe auto power off function and its interval can be ɔecified in the following work areas:

ATSHUTOFF: Overseas version = 0F026H
Japanese-language version = 0ED26H
Contains (in binary form) the interval in minutes between the time the last key is pressed and the time the power automatically turns off. A 00H in this area disables the auto power off function. The initial (default) value is 0AH (10 minutes).

ATSOTIME: Overseas version = 0F027H
Japanese-language version = 0ED27H
The 2-byte area which contains the interval in seconds between the time the last key is

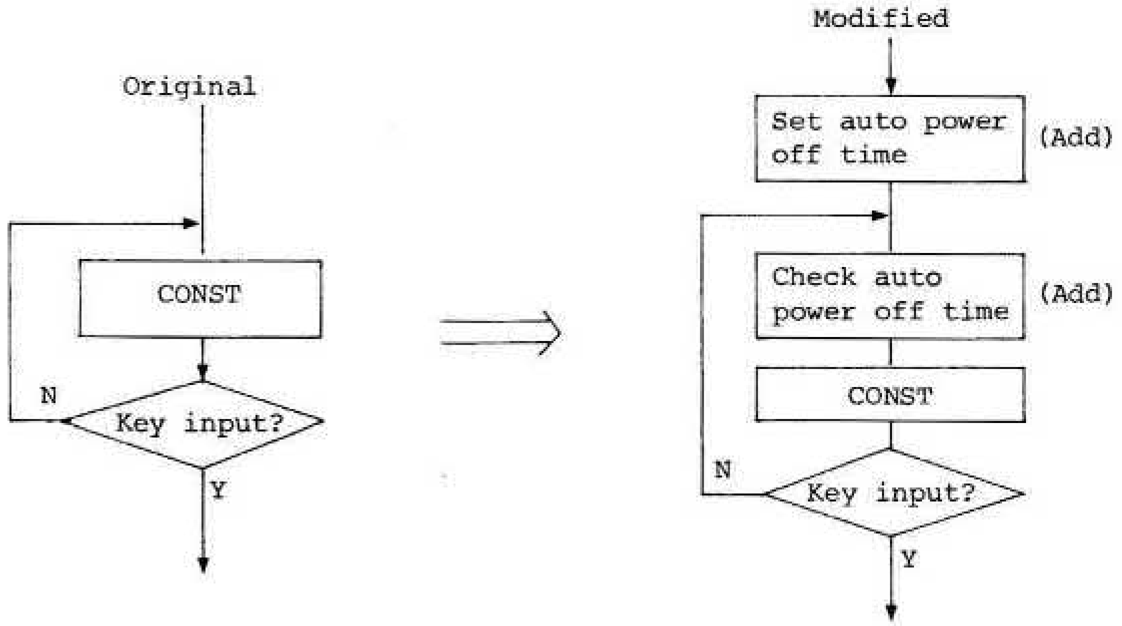
pressed and the time the power automatically turns off. It has the following relationship with ATSHUTOFF:

ATSOTIME = ATSHUTOFF x 60

The initial (default) value is 258H (600 seconds).

When the auto power off interval is to be altered, both fields must always be changed simultaneously.

The auto power off function may not be available for application programs which do not use CONIN for receiving console input but perform console input in their own way polling the keyboard port with CONST. To make the auto power off function available for such programs, add the routines described below to the application program and have it execute the auto power off function by itself.



) Routine for setting the auto power off time

```
LD   HL,(ATSOTIME)     ; Get auto power off
                         interval (in seconds)
LD   DE,(TIMERØ)       ; Get current 1-second
                         clock time
ADD HL,DE
LD (TIMEEND),HL        ; Set 1-clock timer value
                         at which auto power off
                         is to occur
```

) Routine for checking the auto power off time

```
LD   A,(ATSHUTOFF)     ; Check whether auto power
                         off time is defined
OR   A
JR   Z,AAAA            ; Do nothing if not defined
LD   HL,(TIMEEND)      ; Get 1-clock timer value
                         for auto power off
LD   DE,(TIMERØ)       ; Current 1-clock timer
                         value
SBC HL,DE              ; Match?
LD   C,Ø               ; Load continue mode power
                         off parameter
CALL Z,POWEROFF        ; If match, call POWEROFF
                         BIOS function for carry-
                         ing out continue mode
                         power off
EI                     ; Execution resumes at EI
                         instruction when power
                         is turned on again.
AAAA:
```

3) Work area descriptions

Label Name	Address	Size	Description
ATSHUTOFF	Overseas version = ØFØ26H Japanese-language version = ØED26H	1	Contains the auto power off time in minutes. A ØØH in this area disables the auto power off function.
ATSOTIME	Overseas version = ØFØ27H Japanese-language version = ØED27H	2	Contains the auto power off time in seconds. ATSOTIME has the following relationship with ATSHUTOFF: ATSOTIME = ATSHUTOFF x 6Ø
TIMERØ	Overseas version = ØFØ71H Japanese-language version = ØED72H	2	16-bit counter that is incremented by 1 every one second.
TIMEEND	Overseas version = ØF6DCH Japanese-language version = ØF46BH		Loaded with the time at which auto power off is to occur. Filled by the application program.

hapter 8 Alarm/Wake Feature

.1 General

ıe MAPLE is furnished with a 7508 4-bit CPU which ontrols the software timer (clock) and generates ıterrupts to the Z80 CPU at specified intervals. The oftware timer is supported by the alarm/wake OS feature. ıe alarm/wake feature is divided into the following ıree functions:

1) Alarm function
2) Wake1 function
3) Wake2 function

hese functions are identified by software using a flag; nly one type of interrupt is generated by the 7508 CPU or these functions. The 7508 checks for an alarm/wake ıme every 10 seconds even if the MAPLE is in the power ff state, that is, the alarm/wake feature remains vailable when MAPLE power is off. However, the larm/wake processing differs depending on whether MAPLE ower is off or on. The next section explains how larm/wake processing proceeds in both power off and on tates (refer to "OS Specifications" for details).

8.2 Alarm Function

1) What to set

(1) Alarm time (month/day/hour/minute/second (10-second units))

(2) Alarm message (up to 40 alphanumeric, kana, and graphics characters)

2) How to set

(1) Use the System Display (second cannot be specified).

(2) Use the BIOS TIMDAT function (see Chapter 4, "BIOS Calls").

(3) Load the work areas time data and issue a time setting command directly to the 7508 CPU (see Section 8.7 and Chapter 11, "7508 Explanations").

Alarm function in power-on state

alarm function sounds an alarm and displays the time message using the VRAM system screen. This rantees that no user data on the screen be destroyed. n the display is ended, the user data displayed ediately before the alarm message is restored.

time display can be terminated when:

(1) The ESC key is pressed.

(2) 50 seconds has elapsed.

(3) The POWER switch is turned off.

(4) A power failure occurs.

Alarm function in power-off state

alarm function performs the same operations as in power-on state after the MAPLE is powered on. After display is terminated, the original screen before 'er is turned on is restored. If power is switched off back on again while the alarm function is displaying alarm time and message, then the normal power-on uence occurs.

8.3 Wakel Function

1) What to set

(1) Wake time (month/day/hour/minute/second (10-second units))

(2) The name of program to be executed when a wake condition occurs.

2) How to set

Same as the alarm function in 8.2.

3) Wakel function in power-on state

The wake function treats the wake string as an alarm string and performs the same operations as the alarm function.

Wakel function in power-off state

ɪen power is turned on, the wake function loads the ıke string into the key buffer for execution as power- commands.

When the MAPLE is in the restart mode power-off state

The wakel function executes WBOOT and displays the Menu, then enables the wake string for execution under CCP control.

(In Overseas version 2.3 (B), the function enables the wake string for execution under CCP without displaying the menu).

When the MAPLE is in the continue mode power-off state

The wakel function ignores the wake string and returns the MAPLE into the state before it is powered off and continues processing.

e wakel function, when used with the BIOS POWEROFF nction, may find many applications in periodic data llection and other automatic (unattended) operations thout operator's intervention.

8.4 Wake2 Function

1) What to set

   (1) Wake time (month/day/hour/minute/second (10-second units))

   (2) The address of the routine to be executed when a wake condition occurs.

2) How to set

   (1) Use the BIOS TIMDAT function (see Chapter 4, "BIOS Calls").

   (2) Load the work areas time data and issue a time setting command directly to the 7508 CPU (see Section 8.7 and Chapter 11, "7508 Explanations").

3) Wake2 function in power-on state

The wake2 function calls the specified address. See programming note 5) below for the routine to be specified at this address.

Vake2 function in power-off state

ıen the MAPLE is in the restart mode power-off state

When power is turned on, the wake2 function calls the specified address, then returns the MAPLE into the state (restart mode) before power is turned off.

ıen the MAPLE is in the continue mode power-off state

The wake2 function returns the MAPLE into the state before it is powered off, then causes a jump to the specified address. If the destination of the jump is a RET instruction, control is returned to the point in the program at which the MAPLE was powered off in the continue mode.

5) Wake2 function programming notes

(1) Neither BDOS nor BIOS system call can be used in the routine to be called by the wake2 function.

(2) The routine to be executed by the wake2 function must end with a RET instruction.

(3) When the wake2 function is invoked in the power-off state, only power to the main board is turned on and no power is supplied to the I/O devices (e.g., RS-232C, serial port, and ROM capsules). Furthermore, if this condition occurs in the continue mode, the routine to be called by the wake2 function must turn on the power to these devices before executing the RET instruction. See the next page for the procedure for turning on the power to the I/O devices.

(4) The event which called the wake2 function can be identified by examining the following work areas:

- ZSTARTFG: Overseas version = 0F389H

  Japanese-language version = 0F0C9H

  Identifies the source of the invocation of the routine.

  01H: POWER switch on.

  02H: Alarm

  03H: Wake1

  04H: Wake2

ITNFG: Overseas version = ØF33ØH

Japanese-language version = ØFØ5ØH

Identifies the power-off state mode.

= 00H: Continue mode.

≠ 00H: Restart mode.

ΓARTFG	CNTNFG	State from which control is passed to the routine via wake2 function
≠Ø4H	NC	Power-on state.
=Ø4H	ØØH	Continue mode power-off state
=Ø4H	≠ØØH	Restart mode power-off state

routine called by the wake2 function must examine above work areas to identify the power-off state immediately set the work areas as follows:

ZSTARTFG = ØØH

CNTNFG = ØFFH

When called in the continue mode power-off state, the routine must execute the following code before executing the RET instruction:

```
        LD    HL,(ATSOTIME)    ┐
        LD    DE,(TIMERØ)      │ Sets the new auto
        ADD   HL,DE            │ shut-off time.
        LD    (TIMEEND),HL     ┘

        LD    A,(SPOPN)        ┐
        OR    A                │ Checks to determine
        JR    NZ,AAAA          │ whether serial or
        LD    A,(RSCLSF)       │ RS-232C interface has
        OR    A                │ been used and, if so,
        JR    NZ,BBBB          ┘ turns on its driver.

AAAA:                          ── Turns on the driver.
        LD    A,(CTLR2)         ↓
        SET   4,A
        OUT   (2),A
        CALL  ST1ML <────────── 1m-second software timer.
        SET   3,A
        OUT   (2),A
        CALL  ST1ØØML <──────── 1ØØm-second software
        RES   4,A               timer.
        SET   5,A
        LD    (CTLR2),A
        OUT   (2),A
```

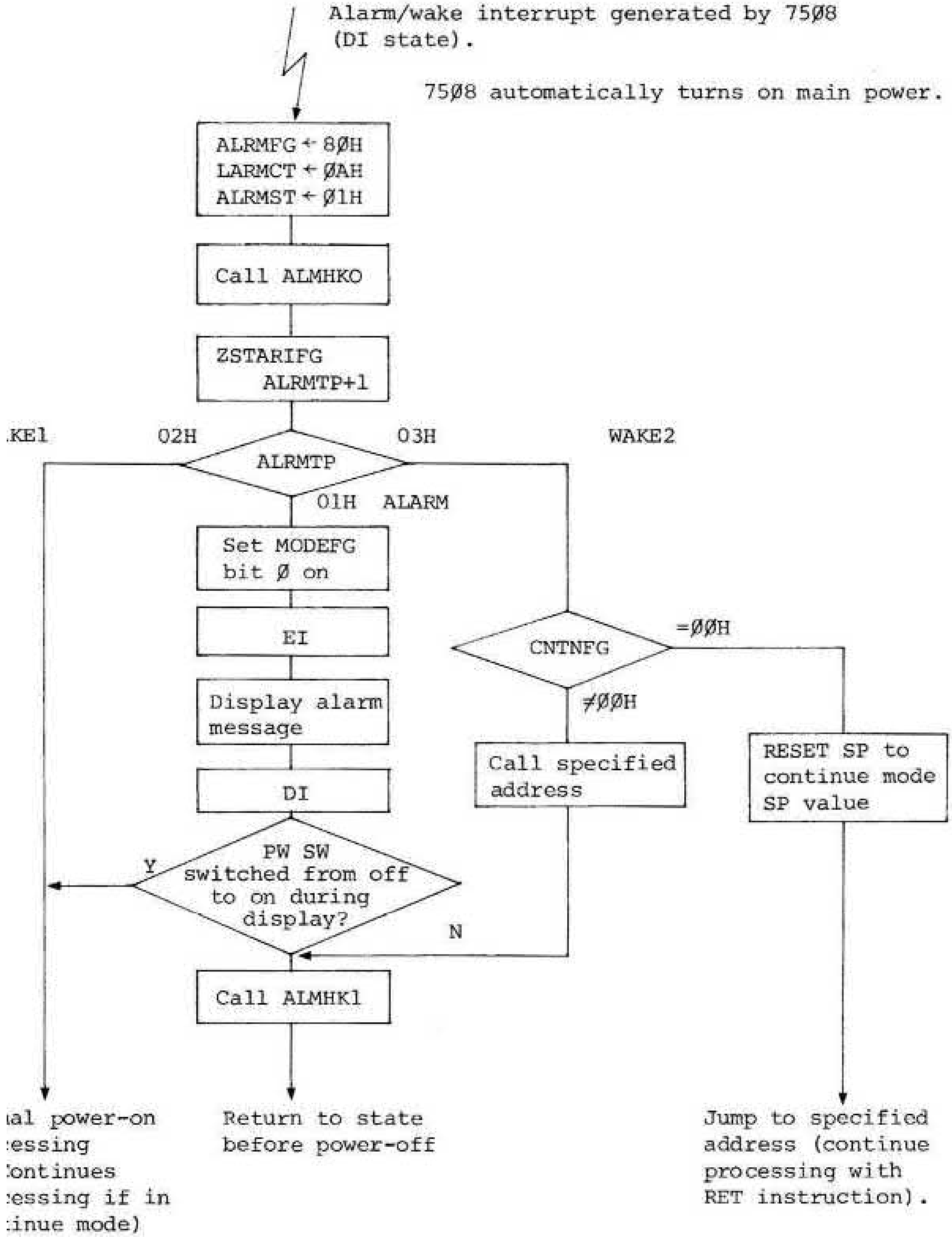
```
B:
    LD      A,(RSCLSF)
    OR      A
    JR      NZ,CCCC

    LD      A,ØBEH
    OUT     (ØDH),A            Initializes 8251 if
    LD      A,Ø4ØH             the RS-232C interface
    OUT     (ØDH),A            has been used.
    CALL    ST1ØØML
    LD      A,(SVRSMOD)
    OUT     (ØDH),A
    LD      A,(SVRSCMD)
    OUT     (ØDH),A

C:
    XOR     A                  Turns off ROM capsule
    LD      (PROMPWR),A        power.


    LD      HL,MTIMEBUF
    LD      DE,YPOFDS
    LD      BC,4
    LDIR

    LD      A,(IER)
    OUT     (Ø4H),A

    LD      A,(CNTNILVL)
    LD      (INTLEVEL),A

    POP     HL
    POP     DE                 Restores registers.
    POP     BC
    POP     AF

    EX      AF,AF'
    EXX
    POP     IY
    POP     IX

    RET
```

Work area address chart

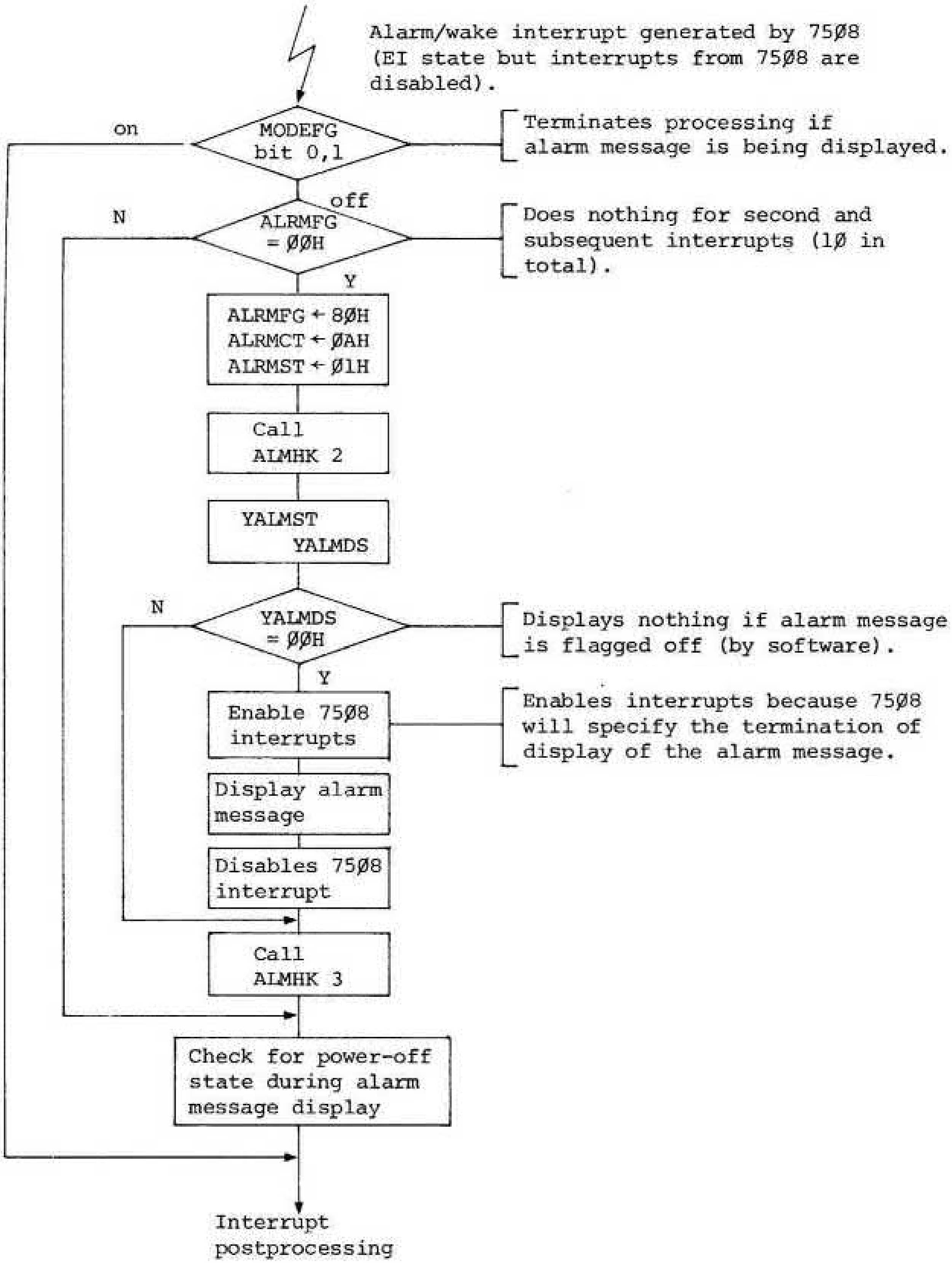
Work area name	Overseas version	Japanese-language version
ATSOTIME	FØ27H	ED27H
TIMERØ	FØ71H	ED72H
TIMEEND	F6DCH	F46BH
SPOPN	F35AH	FØ82H
RSCLSF	F2C8H	EFF8H
CTLR2	FØB2H	ED92H
SVRSMOD	F6DØH	F45DH
SVRSCMD	F6D1H	F45CH
PROMPWR	F1CAH	EEE3H
MTIMEBUF	F4BDH	F232H
YPOFDS	FØD9H	EDB9H
IER	FØB3H	ED93H
CNTNILVL	F385H	FØC5H
INTLEVEL	FØBAH	ED9AH

Alarm/Wake Function Processing Flow

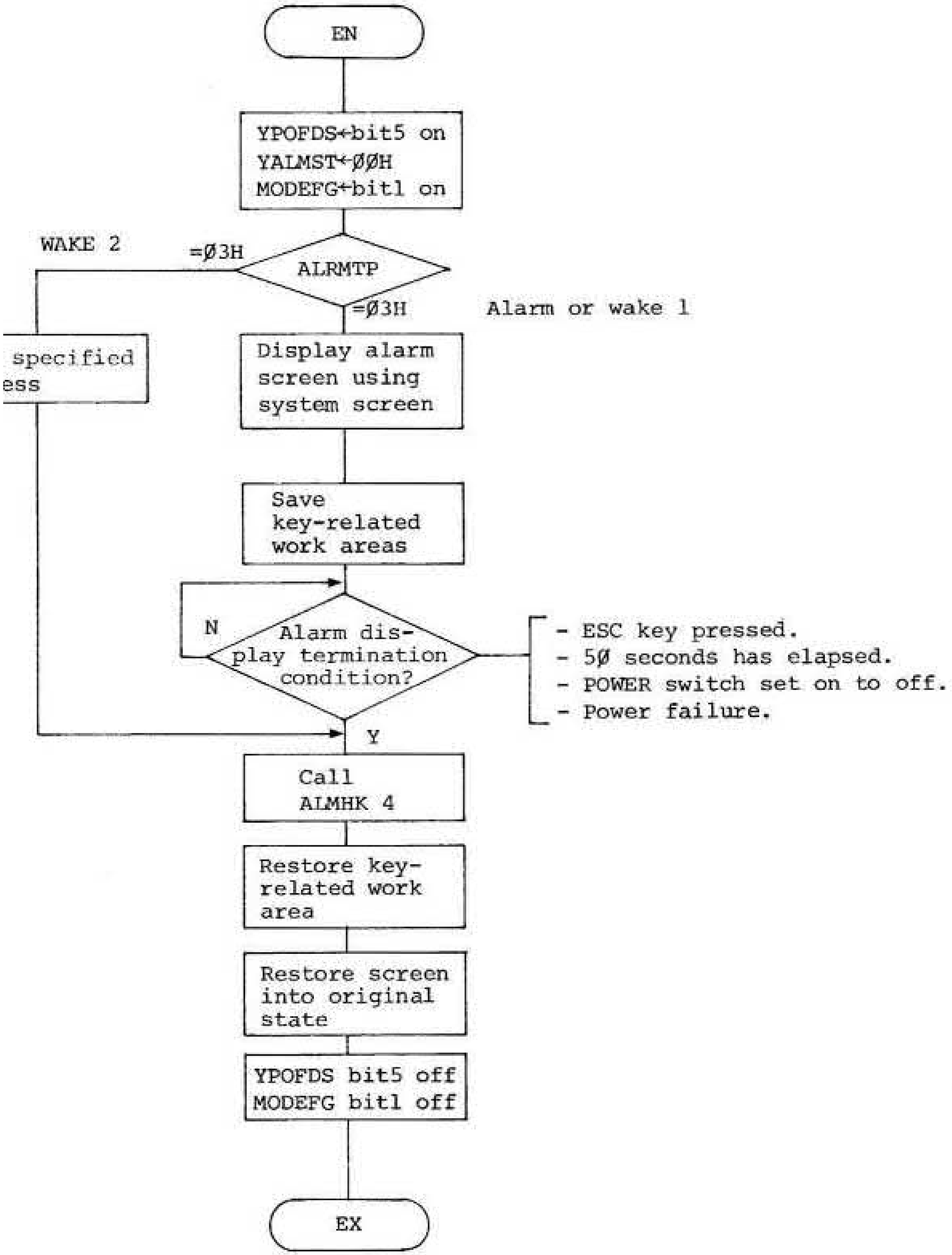
Alarm/Wake processing in the power-off state



2) Alarm/Wake processing in the power-on state

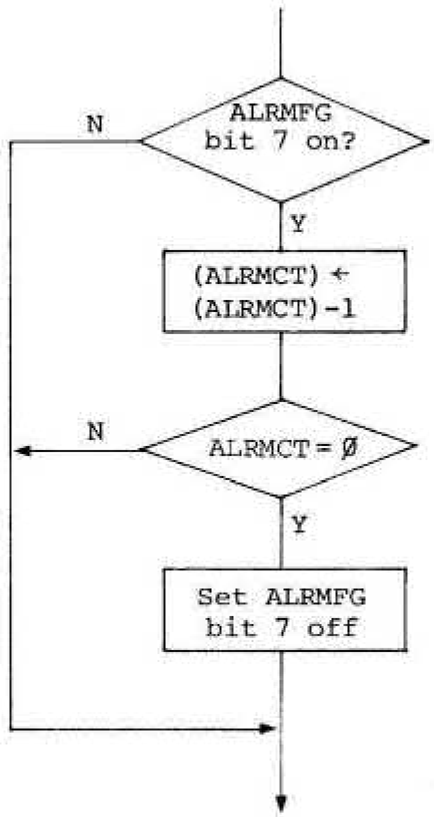


ılarm display processing



4) Alarm processing during 1-second interrupt processing

Since alarm/wake interrupts occur every one second, a total of 10 times during the 10-second period, the interrupt handler ignores the second and subsequent interrupts. Accordingly, the OS examines the ALRMFG flag for 10 seconds (for 10 interrupts) since the first interrupt occurred using the 1-second interrupt processing routine and indicates the results to the alarm/wake processing routine.



The first alarm/wake interrupt sets ALRMFG and ALRMCT flags as follows:

ALRMFG = 8ØH

ALRMCT = ØAH

After 1Ø seconds, ALRMFG is set to ØØH. The interrupt handler ignores any alarm/wake interrupts while ALRMFG is nonzero.

ımary of work areas used by the alarm/wake functions

'ork area name (Address)	Size (in bytes)	Description
RMTP (Overseas rsion = ØFØ6CH, panese-language rsion = ØED6DH)	1	Identifies the type of alarm/wake functions. = ØØH: Undefined = Ø1H: Alarm = Ø2H: Wake1 = Ø3H: Wake2
RMAD (Overseas rsion = ØFØ6DH, panese-language rsion = ØED6EH)	2	Contains the starting address of the alarm message or wake string.
RMST (Overseas rsion = ØFØ6FH, panese-language rsion = ØED7ØH)	1	Indicates whether an interrupt occurred or no for the currently set alarm/wake time. = ØØH: Not occurred. = ØH: Occurred.
RMFG (Overseas rsion = ØFØ7ØH, panese-language rsion = ØED71H)	1	Indicates the time count from the timer when an alarm/wake interrupt occurred (up to 1Ø seconds). Bit 7: Set by the first interrupt and cleare after 1Ø seconds.
DEFG (Overseas rsion = ØFØB8H, panese-language rsion = ØED98H)	1	Indicates the current system status. Bit Ø = 1: Alarm/wake processing invoked from power-off state is in progress. Bit 1 = 1: Alarm/wake processing invoked from power-on state is in progress.

Work area name (Address)	Size (in bytes)	Description
YALMDS (Overseas version = ØFØDBH, Japanese-language version = ØEDBBH)	1	Indicates the alarm/wake disable state. Bit 7 = 1: Disabled because BIOS is in execution. Bit 6 = 1: Disabled because password is being entered. Bit 5 = 1: Disabled because alarm/wake messag is being displayed. Bit 4 = 1: Disabled because system message is being displayed. Bit 3 = 1: Disabled by BASIC. Bit 2 = 1: Disabled by scheduler. Bit 1 = 1: Disabled by MTOS. Bit Ø = 1: Reserved (for applications).
YALMST (Overseas version = ØFØDCH, Japanese-language version = ØEDBCH)	1	Indicates that an alarm/wake interrupt occurre when the alarm/wake functions are disabled. The meanings of the bits are identical to thos of YALMDS.
ALRMCT (Overseas version = ØF4E6H, Japanese-language version = ØF25BH)	1	Contains the number of alarm/wake interrupts. The 75Ø8 generates an interrupt every one second for 1Ø seconds (1Ø in total) for one alarm/wake time.

6 How to Augment the Alarm/Wake Functions Using Hooks

shown in Section 8.5, the alarm/wake functions has ve hooks. The user can extend the alarm/wake nctions by making patches in these hooks. This ction shows how to make patches for these hooks.

ok addresses

	Address	Label	Contents
erseas Ver.	ØEF8CH	ALMHKØ:	JP RETURN
panese Ver.	ØEBD8H		
erseas Ver.	ØEF8FH	ALMHK1:	JP RETURN
panese Ver.	ØEBDBH		
erseas Ver.	ØEF92H	ALMHK2:	JP RETURN
panese Ver.	ØEBDEH		
erseas Ver.	ØEF95H	ALMHK3:	JP RETURN
panese Ver.	ØEBE1H		
erseas Ver.	ØEF98H	ALMHK4:	JP RETURN
panese Ver.	ØEBE4H		
erseas Ver.	ØEEB7H	RETURN:	RET
panese Ver.	ØEBØBH		

e above entries can be hooked to any user-supplied utines by changing the address portion of the JP TURN instruction.

Programming notes that the user must take when changing hook addresses follow.

(1) Take care with bank control.

The hook entries are always called when the system is in the system bank state (addresses ØØØØH through 7FFFH are allocated for ROM and 8ØØØH through ØFFFFH for RAM). No problem will occur as long as the jump addresses in the hook table point to memory addresses 8ØØØH and higher; however, the active bank need be switched to the user bank whenever hook entries are entered if they point to addresses between ØØØØH and 7FFFH. Normally no user-supplied routine can be placed in addresses between ØØØØH and 7FFFH.

(2) Reserve a user stack area.

Since control is transferred to the hook with the stack pointer pointing to the stack for interrupt routines, if the routine pointed to by the hook is to use a stack area (e.g., when using CALL and/or PUSH instructions), it must reserve its own stack area and restores the stack pointer to the original value when it terminates execution.

(3) Save the contents of registers and work areas.

Control is passed to the hook without saving the contents of registers and work areas. Accordingly, if a

: routine specified in the hook is to alter registers
;ystem work areas, it must save the contents of the
isters and work areas to be changed on entry and
:ores them on exit (of course, it can safely alter
contents of work areas which expect alteration by
user).

Do not change the interrupt status.

:e ALMHKØ-ALMHK4 are invoked when the CPU is in one
:he interrupt states listed below, no user-supplied
:ine specified in the hook can change the interrupt
:e. If a user-supplied routine need to change the
errupt state, it must restore the MS into the
jinal interrupt state before terminating processing.

ALMHK0: DI state

ALMHK1: DI state

ALMHK2: EI state (7508 interrupts are disabled.)

ALMHK3: EI state (7508 interrupts are disabled.)

ALMHK4: EI state

Disable interrupts when changing an address in the hook.
system is highly likely to crash if an interrupt
ng a hook entry occurs while the address in that
ry is being changed. Since alteration of jump
resses in the hook is normally done by the user
jram in the TPA, the user program can and should

inhibit such interrupts with a DI instruction to avoid possible system crash. The program, however, must executes an EI instruction after terminating its execution.

(6) Do not call any system routine from the hook.
The hook does not know from what system state it is called because it is invoked by interrupts. It may be called while a system routine (BDOS, BIOS, or internal OS routine) is being executed. A system crash will occur if a routine in the hook calls a system routine in such a situation.

(7) Do not perform an I/O operation.
For the same reason given above, the routines in the hook must not perform any I/O operations such as display on the screen, communication through the RS-232C interface, etc.

(8) Since the jump table in the hook is initialized by system initialize or reset processing (placed into the state described on page 8-19), when the hook routines are to be made resident in memory, write to that effect in the manual. After system initialize or reset processing is performed, run a program for setting up the hook jump table. (Reset processing initializes only the hook jump table and keeps the user BIOS and RAM disk contents

act.)

Generally, the routines to be executed in the hook uld be placed in the user BIOS area. This makes them ident in memory and solves the problem discussed in .

8.7 Making Alarm/Wake Settings Directly for 7508

As explained in Sections 8.2, 8.3, and 8.4, alarm/wake settings can easily be made by means of System Display or BIOS calls. When alarm/wake settings are to be made in interrupt processing routines as scheduled by a scheduler, however, there is no way but to define alarm/wake information directly to the 7508 CPU for the reason given in paragraph (6) in 8.6.

The 7508 subsystem is provided with the following four functions (commands) associated with the alarm/wake feature:

- ALARM (WAKE) SET
- ALARM (WAKE) READ
- ALARM (WAKE) ON
- ALARM (WAKE) OFF

See Chapter 11, "7508 CPU" for details on the above functions and the interface to the 7508.

section describes the procedure for defining the
m, wake1, and wake2 information directly to the 7508

larm setting procedure

Disable interrupts from the 7508.

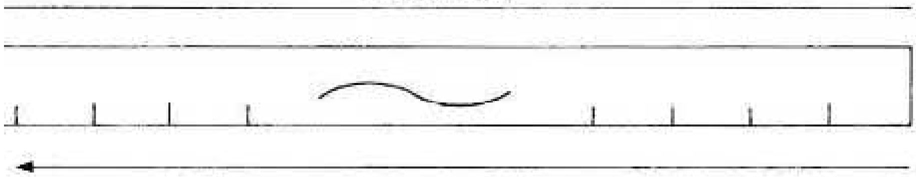
```
LD   A, (IER)
RES  0, A
OUT  (4), A
```

Issue ALARM (WAKE) SET to the 7508 (to set the m/wake time).

Set up the work areas.

- Load ALRMTP with 01H.
- Load ALRMMSG (0F3FFH for overseas version and 0F174H for Japanese-language version) with an alarm message in the following format:

41 bytes



4Ø bytes
(Actual message text is
loaded here)

- Message length (Ø - 4Ø) in binary. A Ø indicates that no message text is defined.
- Load ALRMST with ØØH.

(4) Issue ALARM (WAKE) ON to the 7508 (to enable alarm/wake interrupt).

(5) Enables interrupts from the 7508.

```
LD   A, (IER)
OUT  (4), A
```

Take steps (1) through (5) in sequence.

Wakel setting procedure

Take the same steps as in alarm setting procedure
:ept step 3):

Set up the work areas.

- Load ALRMTP with 02H.
- Load ALRMMSG with a wake string in an appropriate format (a control code is counted as one byte).
- Load ALRMST with 00H.

Wake2 setting procedure

Take the same steps as in alarm setting procedure
:ept step 3):

Set up the work areas.

- Load ALRMTP with 03H.
- Load ALRMAD with the address of the processing routine to be executed when a wake interrupt occurs.
- Load ALRMST with 00H.

8.8 Relationship to BIOS

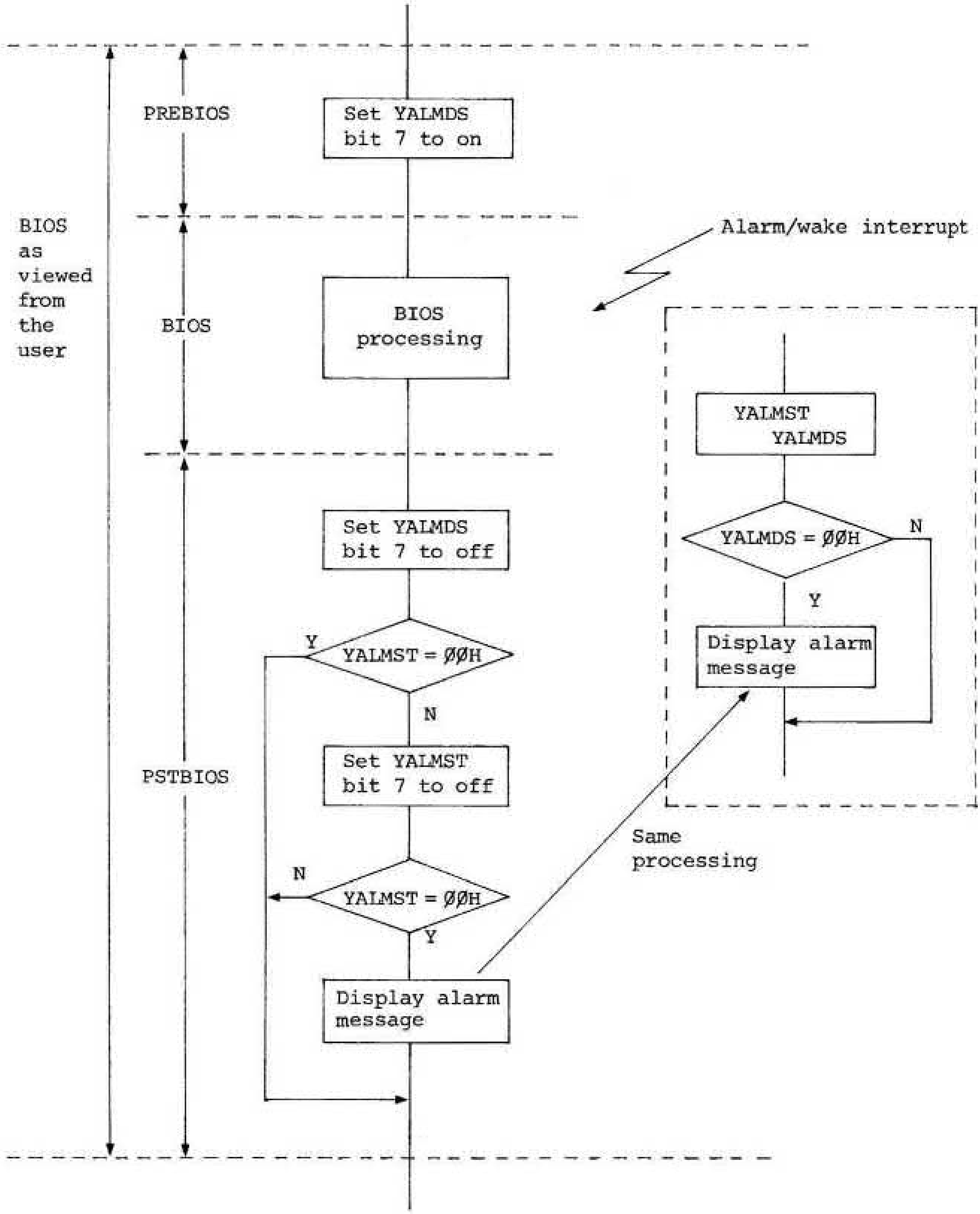
Normal alarm processing displays an alarm message immediately when an alarm interrupt occurs.
When displaying the alarm/wake message, it uses the speaker and screen which are controlled by the slave CPU (63Ø1).
The slave CPU does many I/O operations in addition to alarm/wake operation. If an alarm/wake interrupt occurs while the slave CPU is performing an I/O operation and the associated interrupt processing routine attempts to use the slave CPU, the alarm/wake operation overlaps the executing operation, causing a system hang-up.

The MAPLE takes the following measure to solve this problem:
Since the slave CPU runs only when BIOS is performing an I/O operation, the BIOS preprocessing routine sets a flag on and the BIOS postprocessing routine resets that flag. During the time this flag is on, the alarm/wake interrupt processing routine displays no alarm message when an alarm/wake interrupt occurs. It does nothing but flags to indicate that an interrupt has occurred.
The BIOS postprocessing routine examines this flag to see whether an alarm/wake interrupt has occurred and

;plays an alarm/wake message if the flag is on. The)S preprocessing and postprocessing routines are :led PREBIOS and PSTBIOS, respectively.

: flag indicating whether the alarm/wake message to be displayed or not is stored in the YALMDS work :a. The flag indicating that an alarm/wake interrupt ; occurred while the display of the alarm/wake message disabled is stored in the YALMST work area.

: figure on the next page shows the relationship :ween PREBIOS, PSTBIOS, and BIOS, and the relationship YALMDS and YALMST to BIOS.

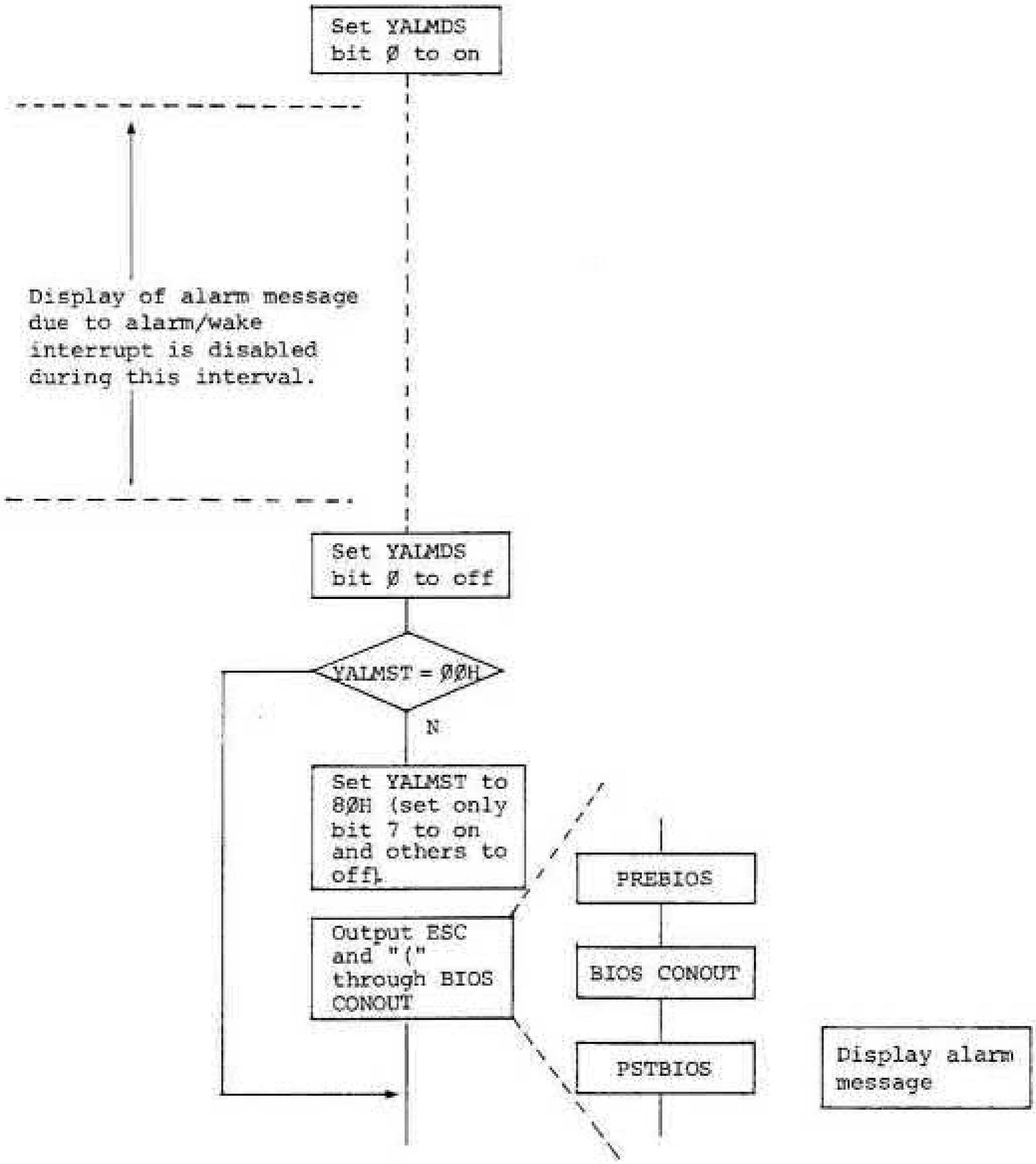

PREBIOS
Set YALMDS bit 7 to on
BIOS as viewed from the user
Alarm/wake interrupt
BIOS
BIOS processing
YALMST YALMDS
YALMDS = ØØH
N
Y
Display alarm message
Set YALMDS bit 7 to off
Y
YALMST = ØØH
N
PSTBIOS
Set YALMST bit 7 to off
Same processing
N
YALMST = ØØH
Y
Display alarm message

9 Method of Inhibiting Alarm Message Display from plication Program

me application programs may not want the alarm message be displayed during execution of some specific erations. The alarm operation can be disabled by ecuting the DI instruction or by inhibiting interrupts om the 7508 CPU. These measures, however, will also hibit other interrupts (e.g., keyboard and power itch off interrupts). To avoid this, the application ogram can and must perform the same operations as EBIOS and PSTBIOS do as explained in 8.8.

splay of the alarm message can be disabled using the LMDS work area. As explained on page 8-18, YALMDS ecifies what mode inhibits the alarm/wake interrupt. t 0 of YALMDS is reserved for application programs. e procedure on the next page shows how to inhibit arm/wake operation from the application program.

When an alarm/wake interrupt occurs while alarm message display is disabled (YALMST contains a nonzero value), set only YALMST bit 7 to on (to make the system believe that the interrupt occurred during BIOS processing) and make a dummy call to BIOS. PSTBIOS will then check YALMST bit 7 and display an alarm message.



The BIOS CONOUT function only passes ESC and "(" ,but no operation results.

10 How to Disable System Display Function for Displaying Alarm/Wake Message

en an application program, e.g., scheduler, controls arm/wake function, malfunctions will result if arm/wake is set or reset from System Display. To avoid is, the MAPLE OS provides a work area for inhibiting e control of the alarm/wake functions through the stem Display.

RMDS: Overseas version = 0F06BH

Japanese-language version = 0ED6CH

= 00H enables the control of the alarm/wake functions through the system display function.

≠ 00H disables the control of the alarm/wake functions through the system display function.

RMDS defaults to 00H.

RMDS is set to 00H by a system initialize.

8.11 Precautions on the Use of the Alarm/Wake Functions

(1) An alarm/wake interrupts are deferred up to 10 seconds in the power-off state. This is because the system checks the alarm/wake time only once every 10 seconds when the MAPLE is in the power-off state.

(2) Since display of the alarm message is inhibited while an BIOS operation is in progress as explained in 8.8, display of the alarm message will be put off accordingly. This should normally be negligible; however, it will be in the order of seconds if the MCT is running.

(3) The Overseas Version B allows the user to change the interval during which the alarm message is displayed (default is 50 seconds) in the range from 1 to 255 seconds.

ALRMPROD (0F2F9H): Load a number from 1-255. Do not specify 0 because the value 0 is interpreted as 0 second or 256 seconds.

hapter 11 7508 CPU

his chapter describes functions and use of the 7508 -bit sub-CPU.

1.1 7508 CPU Functions

he 7508 CPU performs the following functions:

1) Serving keyboard functions such as keyboard scan and auto repeat.
2) Controlling the POWER switch.
3) Controlling the RESET switch.
4) Serving the one-second interval timer function.
5) Measuring the battery voltage.
6) Serving the alarm function.
7) Turning on and off the main CPU switch.
8) Reading temperature data.
9) Serving the calendar and clock functions.
10) Reading data from an AD converter.
11) Controlling the DIP switches.
12) Transferring serial data to and from main CPU.
13) Controlling the DRAM refresh mode.

n addition to generating interrupts, the 7508 CPU ransfers commands and data to and from the Z80 CPU via a serial data line using a handshake technique.

The processing results for functions (1) through (6) on the previous page are returned to the Z80 in the form of interrupts.

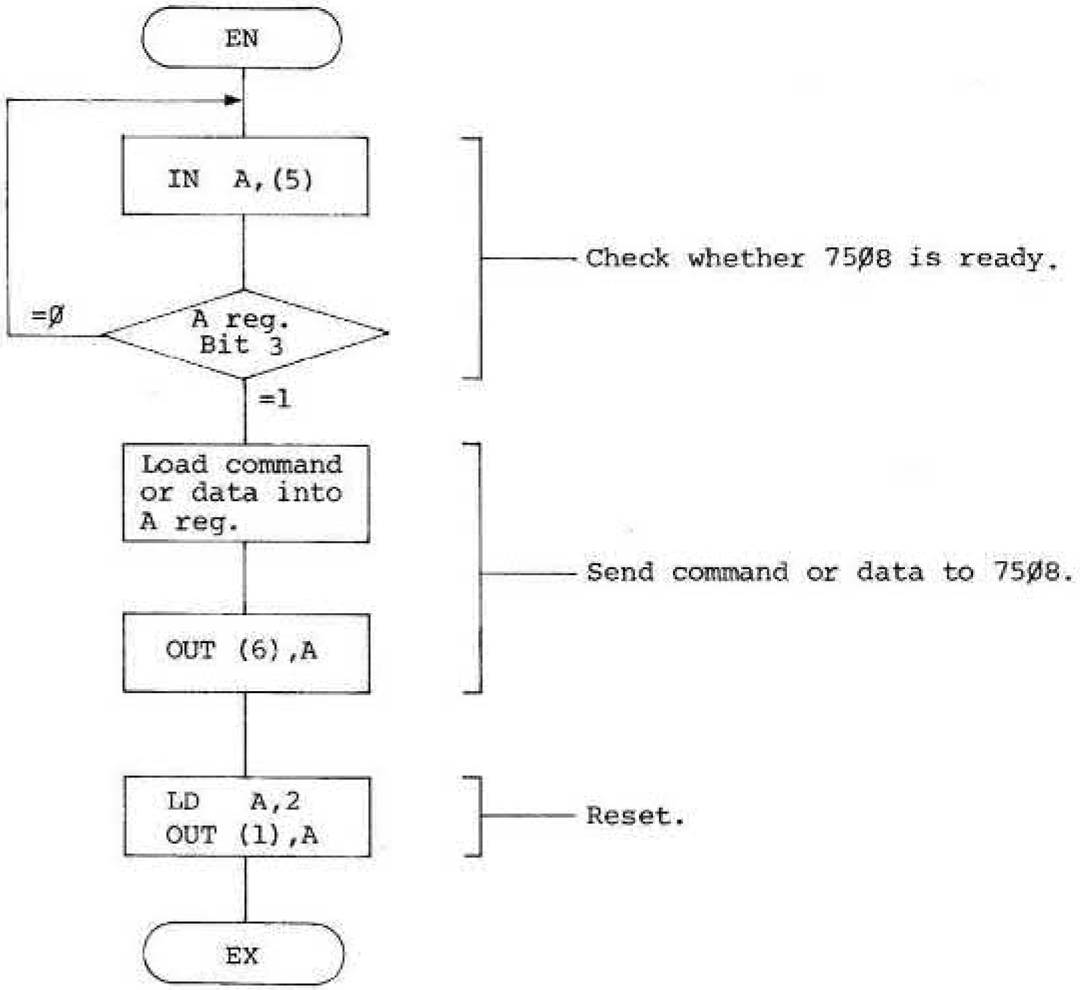
11.2 Interface to Z8Ø

The Z80 CPU uses the following ports when interfacing with the 7508 CPU:

Port	Read/Write	Meaning
06H	Read	Data from the 7508.
	Write	Data to the 7508.
05H	Read	Bit 3 carries the control signal for the serial bus to the 7508. 1: Accessible. 0: Inaccessible.
01H	Write	Used to reset the above control signal. 1: Resets. 0: Does nothing.

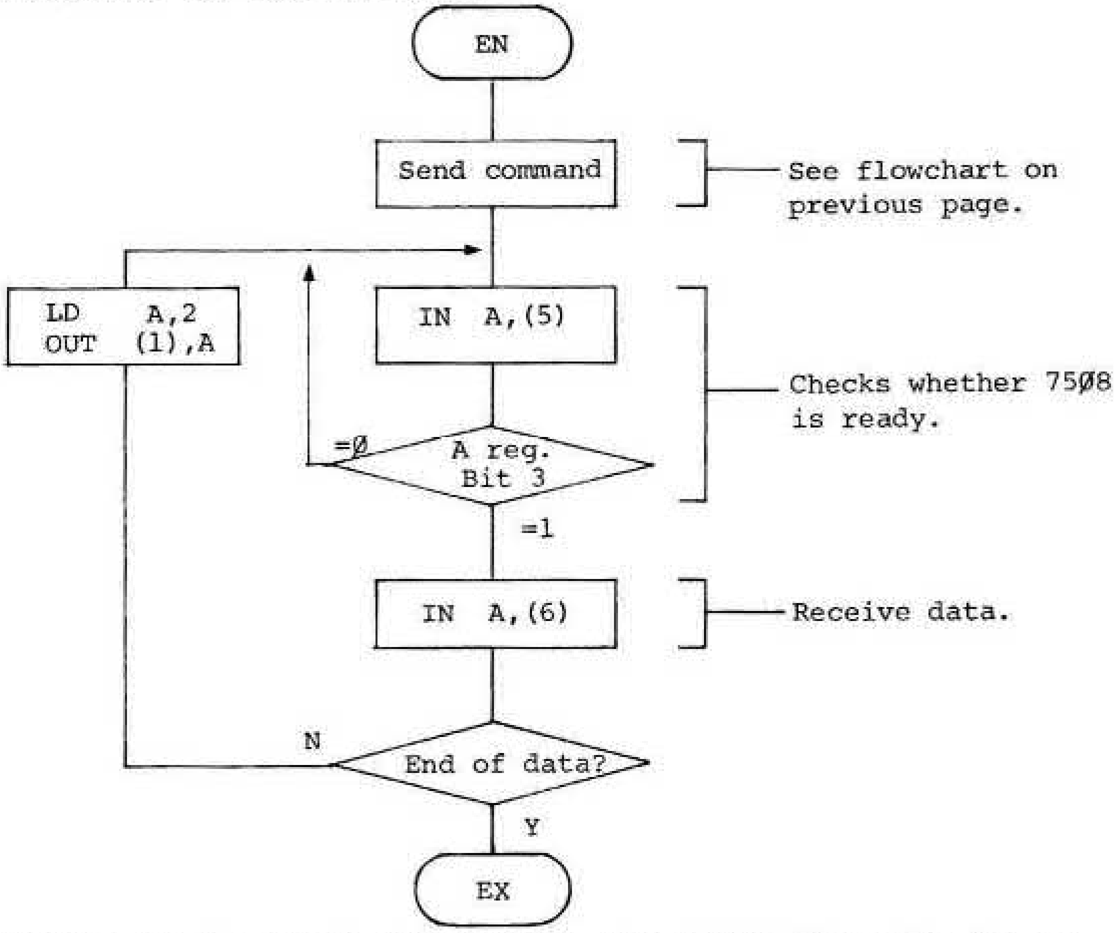
The flowchart on the next page illustrates the procedure for transferring commands or data to and from the 7508 CPU using the above I/O ports.

When sending a command or data to the 75Ø8:



When one or more parameters are to be sent following the command, the above procedure is repeated the number of times equal to the number of command and parameter bytes.

When sending a command and receiving data as the response to the command:



<u>Points to be noted when using the 7508 directly in an application program</u>

1) Disable 7508 interrupts while transferring a command or data to or from the 7508 CPU. (Use the DI instruction or the BIOS MASKI call.)
   If a 7508 interrupt occurs while the application program is communicating with the 7508 CPU, the Z80 CPU may not receive correct return information or, at the worst case, it may hang up because the Z80 CPU will call for a new 7508 service from its interrupt handling routine and consequently the original command to the 7508 CPU will be ignored.

2) Complete the send or receive sequence for a command before proceeding with the next command. Normal processing cannot be guaranteed unless the application program sends or receives the required number of data bytes; otherwise, a system hangup would result in the worst case.

1.3 7508 Commands

he table below lists the commands that the 7508 CPU eceives from the Z80 CPU.

Command Chart

Command function	Code	Command function	Code
Power off Z8Ø	Ø1H	Read time.	Ø7H
Read 75Ø8 status.	Ø2H	Set alarm.	19H
Reset keyboard.	Ø3H	Read alarm.	Ø9H
Set keyboard repeat start time	Ø4H	Disable alarm.	29H
Set keyboard repeat interval.	14H	Enable alarm.	39H
Read keyboard repeat start time	24H	Read battery voltage.	ØCH
Read keyboard repeat interval.	34H	Read temperature.	1CH
Disable keyboard auto repeat.	Ø5H	Read analog input 1.	2CH
Enable keyboard auto repeat.	15H	Read analog input 2.	3CH
Disable key-in interrupt	Ø6H	75Ø8 power-on reset	ØFH
Enable key-in interrupt.	16H	Read DIP-SW	ØAH
Disable one-second interrupt.	ØDH	Set power failure detect voltage.	ØBH
Enable one-second interrupt.	1DH	Set full charge voltage.	1BH
Set time.	17H	Read power or trigger switch.	Ø8H

1) Power off Z80

Code: 01H

Send data: None.

Receive data: None.

Function: Turns off power to the Z80.

Note: This command is not used in application programs. It is used by the POWEROFF BIOS function.

(2) Read 75Ø8 status

Code: Ø2H

Send data: None

Receive data: 1 byte (75Ø8 status)

Function: Reads the 75Ø8 status. It is used to read the 75Ø8 status when an interrupt occurs to identify the interrupt source. The meanings of the status byte are as follows:

- ØBEH and below: Interrupts from the keyboard.
- ØCØH and above: Interrupts from sources other than the keyboard.
- ØBFH: End of status.

1) Interrupts from the keyboard

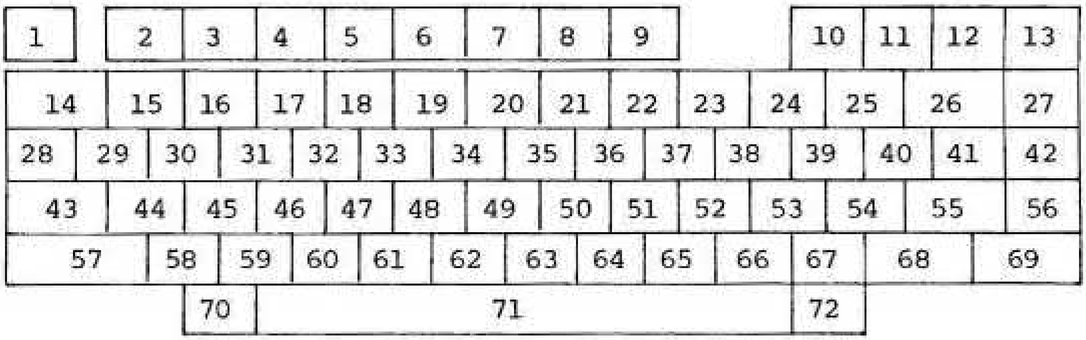
The status byte ØBEH and below indicate interrupts from the keyboard. The correspondence between the keys and status values are shown on the next page. For example, status code 73H is returned when the space key (No. 71 on the keyboard) is pressed.

The 75Ø8 returns only one status code when an ordinary key is pressed and released. For a key No. 43, 57, 7Ø, 72, 68, or 69, however, the 75Ø8 returns a status code (ØB2H - ØB7H) when the key is pressed and returns another code (ØA2H - ØA7H) when it is released.

2) Interrupts from sources other than the keyboard

The status byte ØCØH and above indicate interrupts from sources other than the keyboard. Each bit of the status byte has the meaning listed below. When two or more interrupts occur simultaneously, the corresponding bits are set to 1.

Correspondence between the key numbers and key codes



Higher / Lower	0	1	2	3	4	5	6	7	8	9	A	B
0	2	1	29	46	62	21	37	54	12			
1	3	14	30	47	63	22	38	55	13			
2	4	15	31	48	64	23	39	56			OFF 43	ON 43
3	5	16	32	49	65	24	40	71			OFF 57	ON 57
4	6	17	33	50	66	25	41	58			OFF 70	ON 70
5	7	18	34	51	67	26	42	59			OFF 72	ON 72
6	8	19	35	52	10	27	44	60			OFF 68	ON 68
7	9	20	36	53	11	28	45	61			OFF 69	ON 69
8												
9												

Status

Bit 7: Always set to 1.

Bit 6: Always set to 1.

Bit 5: Set to 1 when a one-second interrupt occurs.

Bit 4: Set to 1 when the RESET switch on the left-side panel of the MAPLE main unit is pressed.

Bit 3: Set to 1 when the INITIALIZE RESET switch on the rear panel of the main unit is pressed.

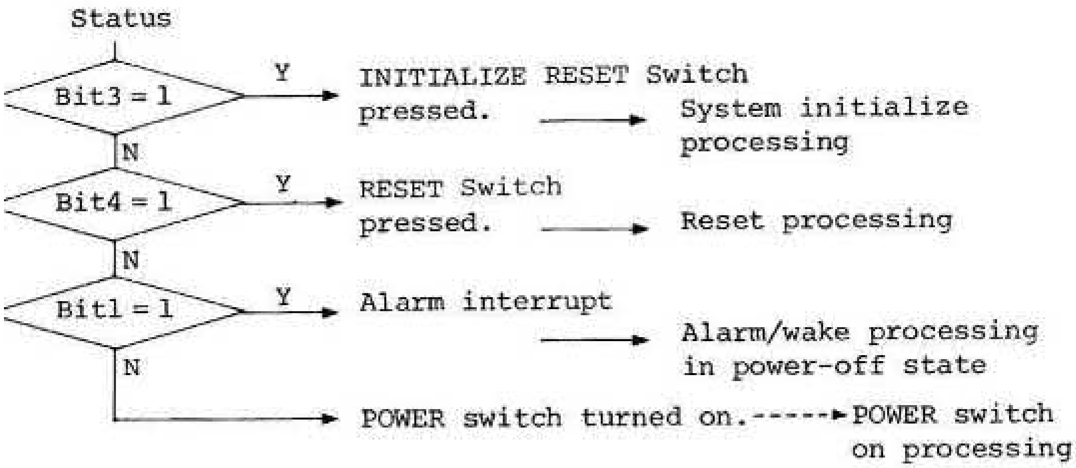
Bit 2: Set to 1 when a power fail interrupt occurs.

Bit 1: Set to 1 when an alarm interrupt occurs.

Bit Ø: Indicates the POWER switch state.
- 1: Power turned on.
- Ø: Power turned off.

This status information is used to distinguish between address Ø start interrupts and power-on interrupts.

i) The source of an address Ø start interrupts (Z80 CPU starting at address 0) can be identified by examining the status bits in the sequence shown below.



ii) 16 status values may be returned by power-on interrupts. Since status byte bit Ø always indicates the state of the POWER switch, the correct interrupt source cannot be determined unless the POWER switch state immediately before the interrupt is known. The table below is used to identify the interrupt source for status values of ØCØH through ØC7H. The interrupt sources for status values of ØEØH through ØE7H correspond to ØCØH through ØC7H on a one-to-one basis and their meanings are identical except that they also indicate the occurrence of a 1-second interrupt.

Status	POWER switch state before interrupt	
	OFF	ON
CØH		POWER switch turned off.
C1H	POWER switch turned on.	•
C2H	Alarm interrupt	POWER switch off and alarm interrupts occurred simultaneously.
C3H	POWER switch turned on.	Alarm interrupt.
C4H	Power fail interrupt	POWER switch turned off.
C5H	Power fail interrupt	Power fail interrupt
C6H	Power fail interrupt	POWER switch turned off.
C7H	Power fail interrupt	Power fail interrupt

*1: Since power is already turned on, the interrupt handling routine need nothing but to set the flag.

*2: This state cannot occur.

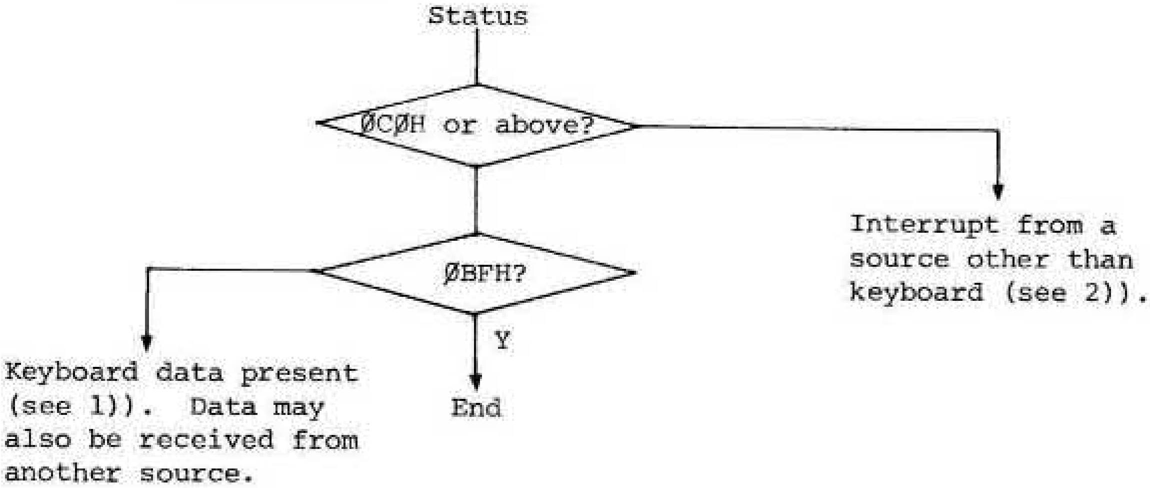
Interrupts are handled as follows when more than one status bit is 1:

- The power fail interrupt has the highest priority.
- Processing of the alarm interrupt may be deferred since a total of 10 alarm interrupts are generated.

For interrupt status values 0E0H to 0E7H, the interrupt handling routines need only perform one-second interrupt processing in addiction to the interrupt processing associated with status values 0C0H to 0C7H.

3) When the status value is 0BFH

The 7508 sub-CPU has a 7-byte buffer for storing keyed in data. It returns status code 0BFH when its key buffer holds no keyboard data. To read all data in the keyboard buffer, the application program need only execute this command repeatedly until a 0BFH code is received.



(3) Reset keyboard

Code: Ø3H

Send data: None.

Receive data: None.

Function:

1) Initializes the keyboard as follows:

- Sets the keyboard repeat start time to 656 ms.
- Sets the keyboard repeat interval to 7Ø ms.
- Clears the buffer.
- Enables interrupts from the keyboard.

2) Scans the keyboard and places the information concerning the currently pressed key.

(4) Set keyboard repeat start time

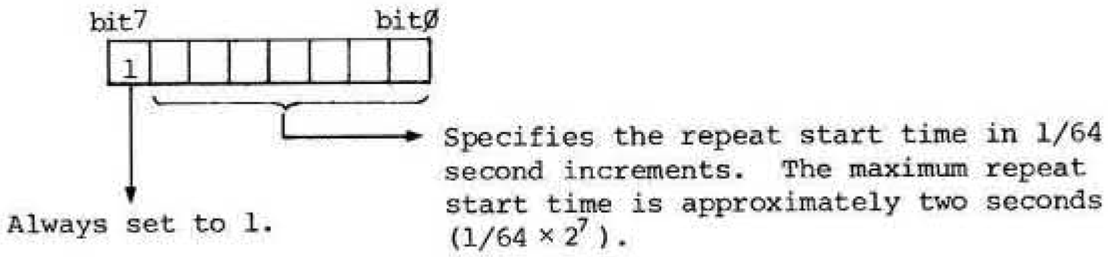
Code: Ø4H

Send data: 1 byte

Receive data: None.

Function: This command defines the interval between the time when a key is first pressed (one key code is loaded into the buffer) and the time when the auto repeat function is to be started. This function causes a key code to be read repeatedly as long as the corresponding key is held pressed.

The send data is made up of one byte and has the following format:



5) Set keyboard repeat interval

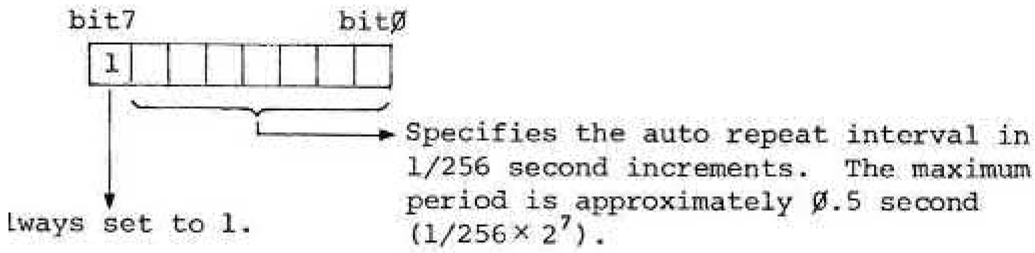
Code: 14H

Send data: 1 byte

Receive data: None.

Function: Defines the interval at which the key code of a key being held pressed is to be entered repeatedly.

The send data consists of one byte and has the following format:



6) Read keyboard repeat start time

Code: 24H

Send data: None.

Receive data: 1 byte

Function: Returns the currently set keyboard repeat start time. The send data specifies the keyboard repeat start time in 1/64 second increments. Bit 7 is always set to Ø.

(7) Read keyboard repeat period

Code: 34H

Send data: None.

Receive data: 1 byte

Function: Returns the currently set keyboard repeat interval. As with command (5), send data specifies the repeat interval in 1/256 second increments. Bit 7 is always set to Ø.

(8) Disable keyboard auto repeat

Code: Ø5H

Send data: None.

Receive data: None.

Function: Disables the keyboard auto repeat function.

(9) Enable keyboard auto repeat

Code: 15H

Send data: None.

Receive data: None.

Function: Enables the keyboard auto repeat function.

(1Ø) Disable key-in interrupts

Code: Ø6H

Send data: None

Receive data: None

Function: Disables key-in interrupts to the Z80 CPU. When a key is pressed after this command is executed, only the key code is placed in the 7508 buffer and no interrupt request is sent to the Z80 CPU. When a command (11) is subsequently executed, a key-in interrupt is generated at this moment to the Z-80 unless the buffer is empty.

(11) Enable key-in interrupts

Code: 16H

Send data: None.

Receive data: None.

Function: Enables key-in interrupts to the Z80 CPU.

(12) Disable one-second interrupts

Code: 0DH

Send data: None.

Receive data: None.

Function: Disables one-second interrupts.

(13) Enable one-second interrupts

Code: 1DH

Send data: None.

Receive data: None.

Function: Enables one-second interrupts.

(14) Set time

Code: 17H

Send data: 8 bytes

Receive data: None.

Function: Specifies the year, month, day, hour, minute, second, and day of the week for the calendar/clock controlled by the 7508 CPU. The send data has the following format:

	bit 7	4	3 bit Ø
①	1	Ø Ø Ø	Tens digit of year
②	1	Ø Ø Ø	Units digit of year
③	1	Tens digit of month	Units digit of month
④	1	Tens digit of day	Units digit of day
⑤	1	Tens digit of hour	Units digit of hour
⑥	1	Tens digit of minute	Units digit of minute
⑦	1	Tens digit of second	Units digit of second
⑧	1	Ø Ø Ø	Day of the week

All items are defined in BCD notation. The calendar/clock is updated when the last parameter byte is received. Any item whose bits are set to all 1s is not updated (this allows partial update). The day of the week is automatically updated within the range Ø through 6.

Since the 75Ø8 CPU makes no check on the set data, the contents of the calendar/clock will not be guaranteed if logically invalid data is given.

Bit 7 of send data bytes is always set to 1. The time is represented in 24-hour system.

(15) Read time

Code: Ø7H

Send data: None.

Receive data: 8 bytes

Function: Reads the contents of the 75Ø8 calendar/clock. The format of the send data is shown below. All items are specified in BCD.

	bit 7 … 4	3 … bit Ø
①	Ø Ø Ø Ø	Tens digit of year
②	Ø Ø Ø Ø	Units digit of year
③	Tens digit of month	Units digit of month
④	Tens digit of day	Units digit of day
⑤	Tens digit of hour	Units digit of hour
⑥	Tens digit of minute	Units digit of minute
⑦	Tens digit of second	Units digit of second
⑧	Ø Ø Ø Ø	Day of the week

(16) Set alarm

Code: 19H

Send data: 6 bytes

Receive data: None.

Function: Sets the month, day, hour, minute, second, and day of the week for the alarm. The format of send data is as follows:

	bit 7	4	3 bit Ø
①	1	Tens digit of month	Units digit of month
②	1	Tens digit of day	Units digit of day
③	1	Tens digit of hour	Units digit of hour
④	1	Tens digit of minute	Units digit of minute
⑤	1	Ø Ø Ø	Units digit of second
⑥	1	Ø Ø Ø	Day of the week

All items are specified in BCD. Items whose bits are all 1s are "don't care." (Setting the minute field to all 1s causes alarm interrupts to be generated every minute.) The second must be set in ten second increments.

The time is represented in 24-hour system. Bit 7 of send data bytes is always set to 1. Since the 7508 makes no check on the set data, the contents of the alarm will not be guaranteed if logically invalid data is sent to the 7508 CPU.

Command (19) must be executed after this command to enable the alarm function.

(17) Read alarm

Code: 09H

Send data: None.

Receive data: 6 bytes

Function: Reads the currently set alarm time (month, day, hour, minute, second, and day of the week).

The send data must be specified in the following format:

	bit 7 ... 4	3 ... bit ∅
①	Tens digit of month	Units digit of month
②	Tens digit of day	Units digit of day
③	Tens digit of hour	Units digit of hour
④	Tens digit of minute	Units digit of minute
⑤	∅ ∅ ∅ ∅	Units digit of second
⑥	∅ ∅ ∅ ∅	Day of the week

All items are specified in BCD notation.

(18) Disable alarm

Code: 29H

Send data: None.

Receive data: None.

Function: Disables alarm interrupts to the Z80 CPU.

(19) Enable alarm

Code: 39H

Send data: None.

Receive data: None.

Function: Enables alarm interrupts to the Z80 CPU. It must be executed at least once after the alarm is set by command (16). (This command may be executed before setting the alarm time.)

(20) Read battery voltage

Code: ØCH

Send data: None.

Receive data: 1 byte

Function: Reads the main battery voltage in digital form. The relationship between the voltage and receive data is shown in the figure on the next page.

(21) Read temperature

Code: 1CH

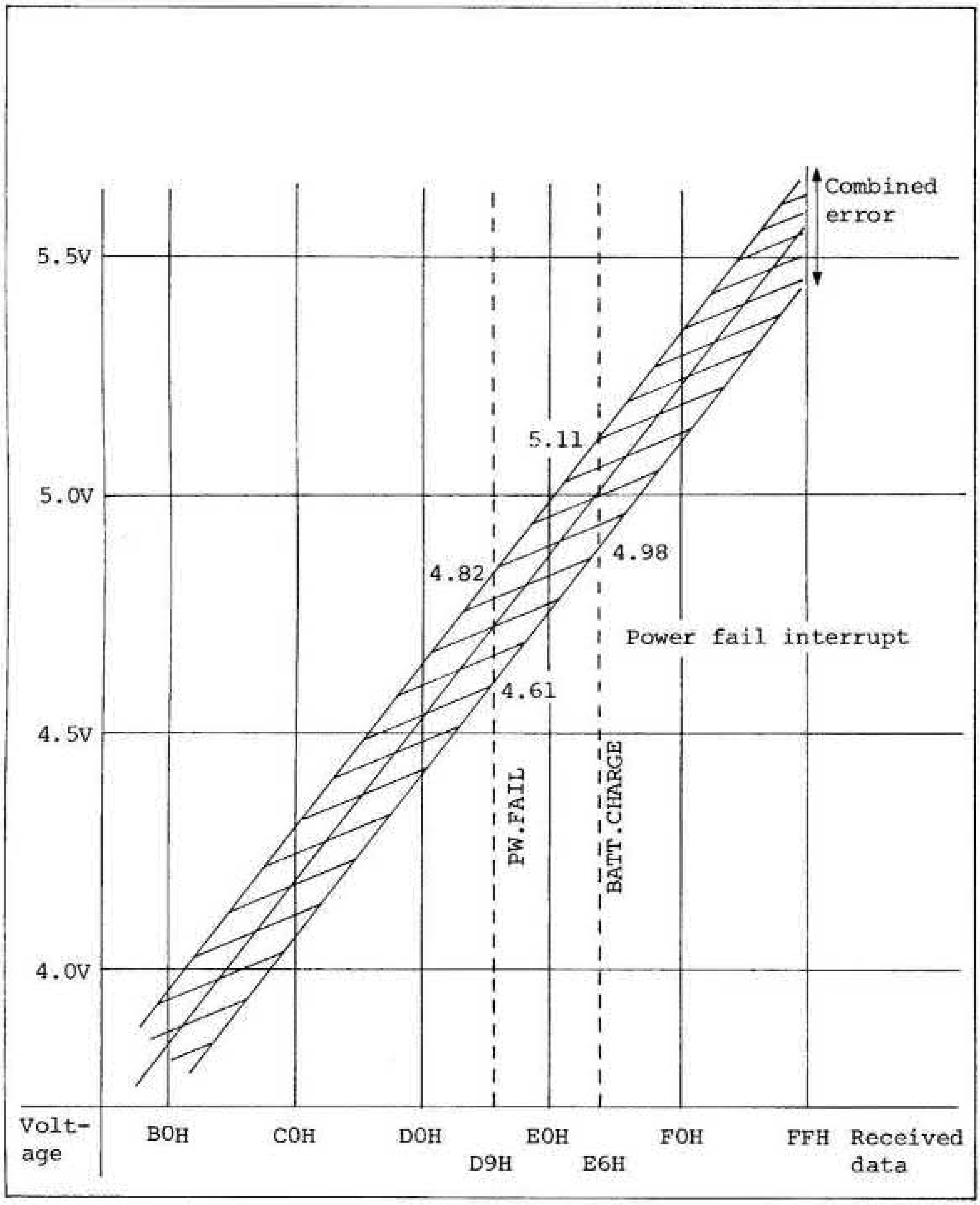
Send data: None.

Receive data: 1 byte

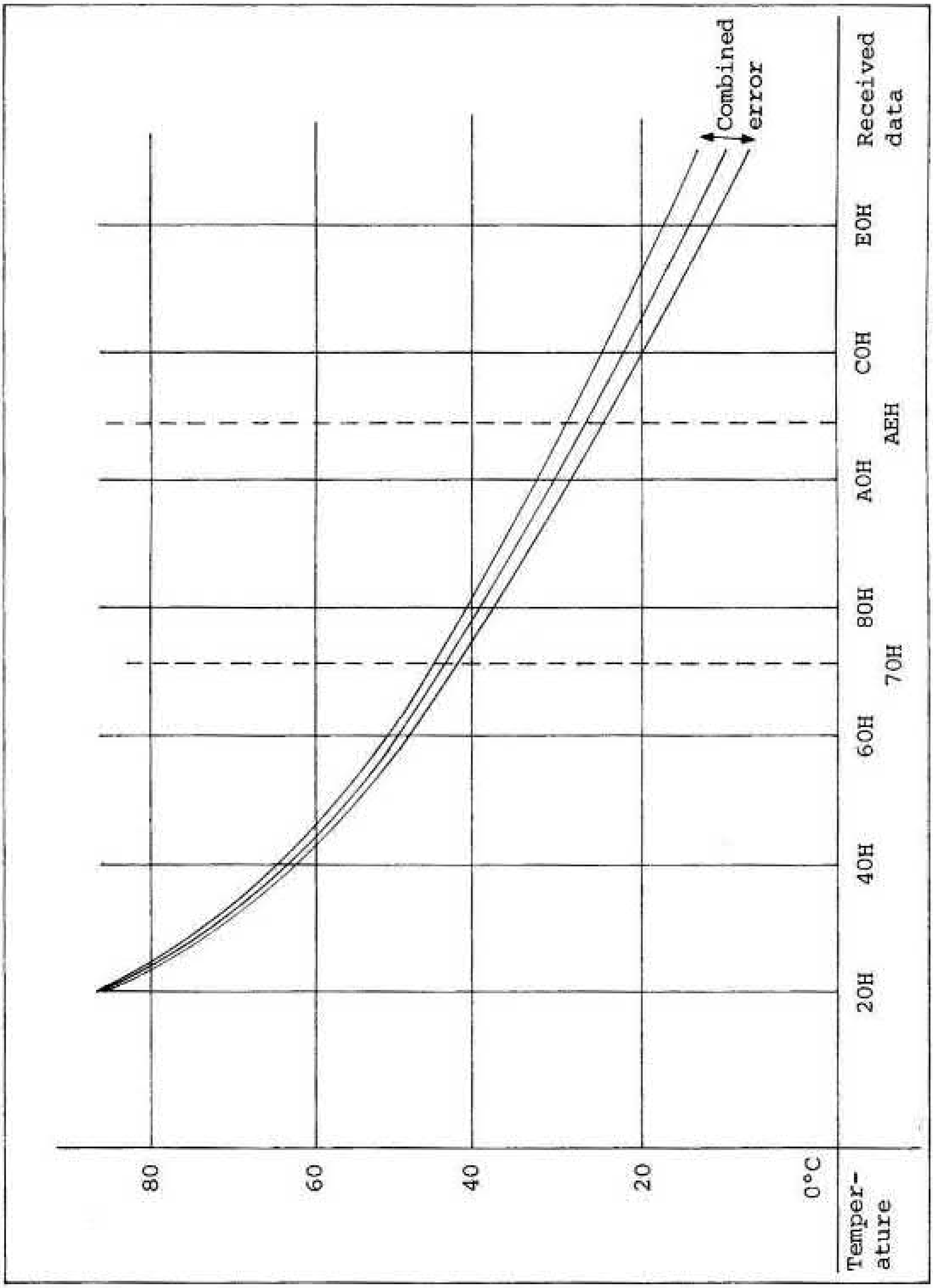
Function: Reads the current temperature in digital form. The relationship between the temperature and receive data is shown in the figure on the next page.

Battery voltage and receive data (7508)

- The receive data is linearly proportional to the battery voltage.
- The combined errors including the scatters of resistance and standard voltage are shown below.



The graph below shows the correspondence between the temperature and the received data with combined errors.



(22) Read analog jack 1

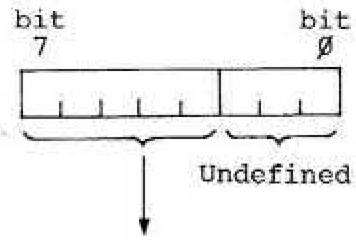
Code: 2CH

Send data: None.

Receive data: 1 byte

Function: Converts analog data from the analog data input jack to digital data.

The received data has the following format:



The highest order 6 bits represent analog data voltages Ø to +2 V. Each bit represent an increment of $2V \div 2^6 \cong 32$ mV (resolution). These bits are set to all 1s when a voltage higher than +2V is input. They are set to Ø when a negative voltage is input.

(23) Read analog jack 2

Code: 3CH

Send data: None.

Receive data: 1 byte

Function: Converts analog data from the bar code reader jack to digital data. The format of the received data is the same as that for the Read Analog jack 1 command (22) .

(24) 75Ø8 power-on reset

Code: ØFH

Send data: None.

Receive data: None.

Function: Resets (initializes) the 7508 sub-CPU.

Note: This command is not used by application programs.

(25) Read DIP-SW

Code: ØAH

Send data: None.

Receive data: See Chapter 15.

Function: Reads the settings of the DIP switches on the main unit rear panel. See Chapter 15 for the functions of the individual DIP switches.

(26) Set power failure detect voltage

Code: ØBH

Send data: 1 byte

Receive data: None.

Function: Defines the voltage at which power fail interrupts are to be generated to the Z-8Ø CPU. A power fail interrupt is generated when battery voltage falls below this voltage. The relationship between the send data and the set voltage is the same as that shown in the figure on page 11-24.

(27) Set full charge voltage

Code: 1BH

Send data: 1

Receive data: None

Function: Defines the voltage at which full charging for the back-up battery is to be started. The relationship between the send data and the set voltage is the same as that shown on page 11-24.

There are tow ways to charge batteries: full charging (a battery is fully charged in eight hours) and trickle charging (a battery is fully charged in 3Ø hours). When the AC adapter is connected, full charging is performed for the first eight hours and then switched to trickle charging. Battery voltage drops gradually if the MAPLE is kept in operation during a tickle charge. This command is used to set the voltage at which full charging is to be started.

(28) Read POWER or TRIGGER switch

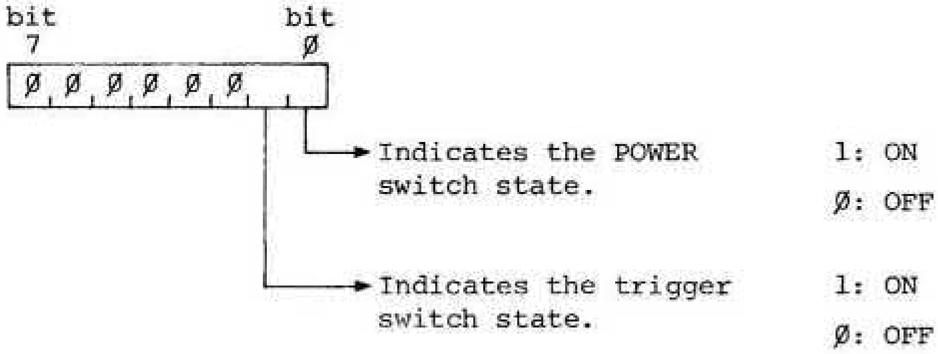
Code: Ø8H

Send data: None.

Receive data: 1 byte

Function: Reads the state of the POWER switch (slide switch) on the main unit right-side panel or the state of the analog data input connector trigger.

The receive data has the following format:



Chapter 12 Using 8251A Programmable Serial Controller

The MAPLE uses a CMOS type RS-232C controller equivalent to the Intel 8251A Programmable Serial Controller. Refer to an 8251A manual for details on the functions and specifications for the 8251A. This chapter explains how to interface the Z80 CPU with the 8251A and how to control the transmitter/receiver clocks that determine the bit rate of the RS-232C interface.

12.1 Interface between the Z8Ø and the 8251A

The Z80 CPU can exchange commands and data with the 8251A through the I/O port addresses 0CH and 0D.

Port	Read Mode	Write Mode
0CH	8251A receive data	8251A send data
0DH	8251A status	Command to 8251A

The Z80 CPU uses no special sequence when accessing I/O port addresses 0CH and 0D. Refer to an 8251A manual for the meanings of the 8251A status and commands.

?.2 Controlling the 8251A Transmitter/Receiver Clocks

ıe 8251A needs a clock with a frequency 1x, x16, or ;4 times higher than the bit rate when it is to be ;ed in asynchronous mode. The MAPLE controls the .ock generator for that clock by outputting a command ıta into bits 4-7 of port 00H. The bit rate factor (1, X16, or X64) can be specified by outputting a mode ›mmand into the 8251A.

› output data into port 0, use the following sequence:

```
LD    A, (CTLR1)
AND   0FH
OR    [    ]          ;Bits 7-4: Select one of the
                       clocks listed in the table on the
                       next page.
                       Bits 3-0: Set to all zeros.
LD    (CTLR1), A
OUT   (0), A
```

CTLR1: Overseas version = 0F0B0H

Japanese-language version = 0ED90H

CTLR1 is the data output to port 0.

Port Ø				Clock		RS-232C Baud Rate			
						X 16		X64	
bit 7	bit 6	bit 5	bit 4	Transmit (TxC)	Receive (RxC)	Transmit (Tx)	Receive (Rx)	Transmit (Tx)	Receive (Rx)
Ø	Ø	Ø	Ø	1.74545 KHz	←	110	←		
Ø	Ø	Ø	1	2.4K	←	150	←		
Ø	Ø	1	Ø	4.8K	←	300	←		
Ø	Ø	1	1	9.6K	←	600	←	150	←
Ø	1	Ø	Ø	19.2K	←	1200	←	300	←
Ø	1	Ø	1	38.4K	←	2400	←	600	←
Ø	1	1	Ø	76.8K	←	4800	←	1200	←
Ø	1	1	1	153.6K	←	9600	←	2400	←
1	Ø	Ø	Ø	19.2K	1.2K	1200	75		
1	Ø	Ø	1	1.2K	19.2K	75	1200		
1	Ø	1	Ø	307.2K	←	19200	←	4800	←
1	1	Ø	Ø	3.2K	←	200	←		

Note: Some MAPLE overseas versions do not support a bit rate of 2ØØ (32 KHz clock).

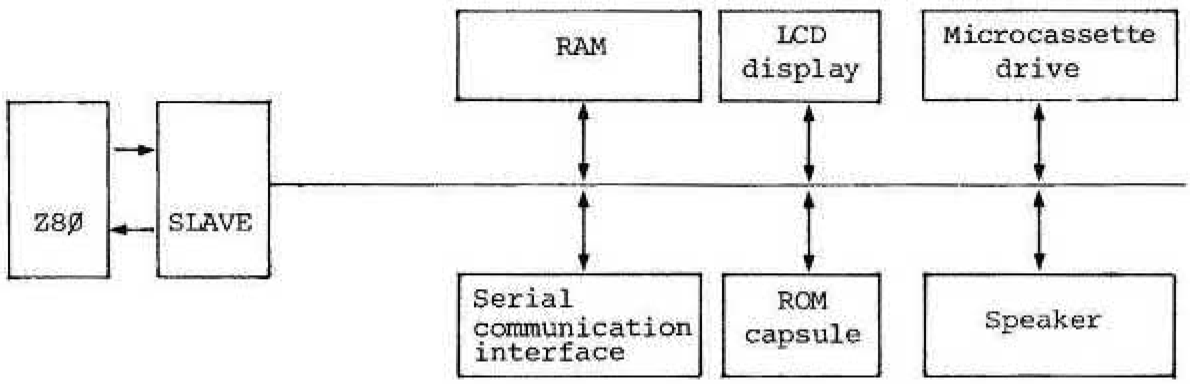
Chapter 13 6301 Slave CPU Operations

13.1 Functions

The 6301 slave CPU controls the following six types of devices:

- RAM
- LCD display
- Microcassette drive
- Serial communication interface
- ROM capsule
- Speaker

The slave CPU runs on its own control programs so that the Z80 CPU need only issue commands to the slave system to control the above devices. The Z80 commands to the slave CPU are detailed in Section 13.5.



(1) RAM

The slave CPU has 6K bytes of RAM which is located at slave system memory locations 8000H and higher. This RAM contains the VRAM and external character areas; it is mainly used for screen-oriented operations. The RAM is also loaded with the control programs for the slave CPU. The memory configuration of this RAM is shown on page 13-3.

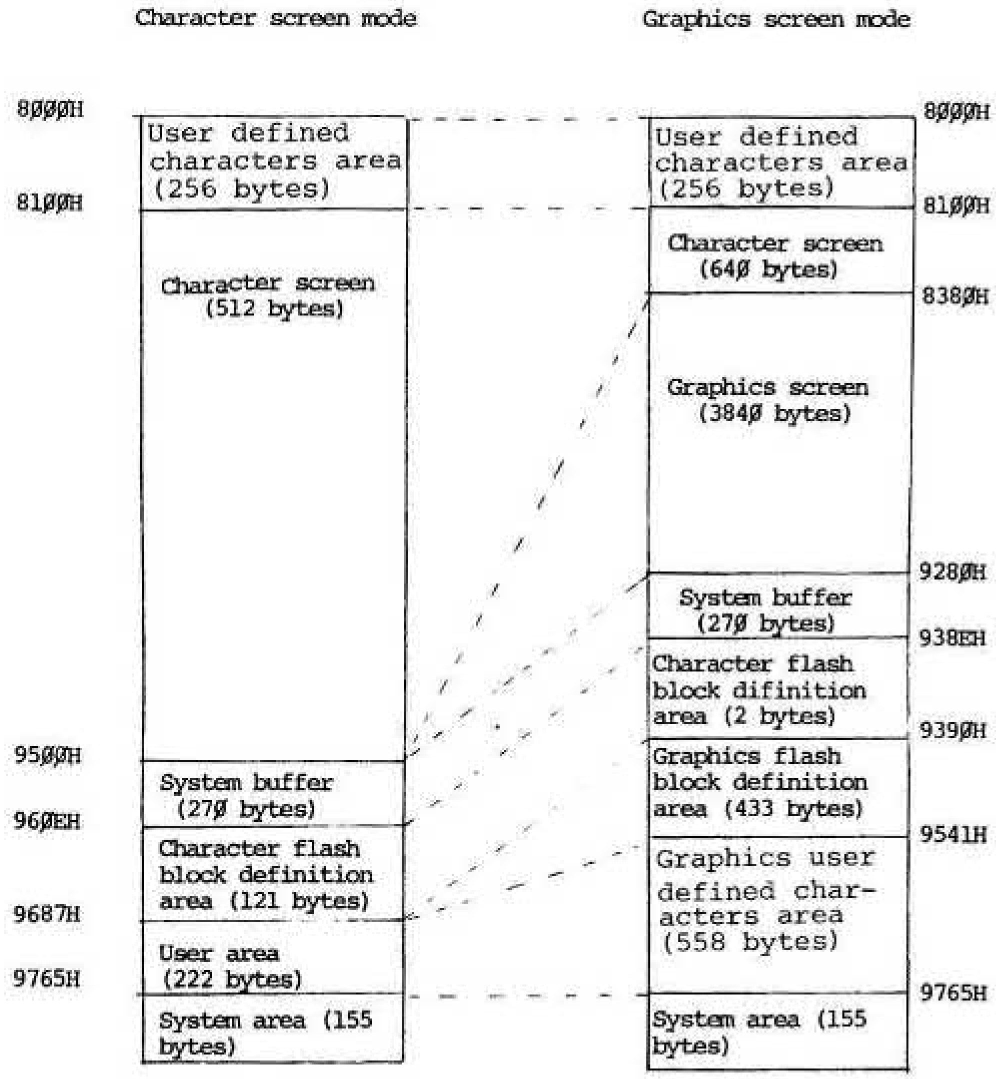
(2) LCD display

1) Theory of operation

The data to be displayed on the LCD is fetched by the LCD controller from RAM for display; the Z80 CPU need only place the display data into the specified RAM area.

There are two screen modes: the character and graphics modes. In the character mode, the LCD controller receives 1-byte character codes from the character screen area and searches the character generator in the controller for the corresponding (6 x 7 dots) font for display on the LCD. For user defined characters, it searches the user defined characters area at the beginning of the RAM for display.

Slave System Memory Map

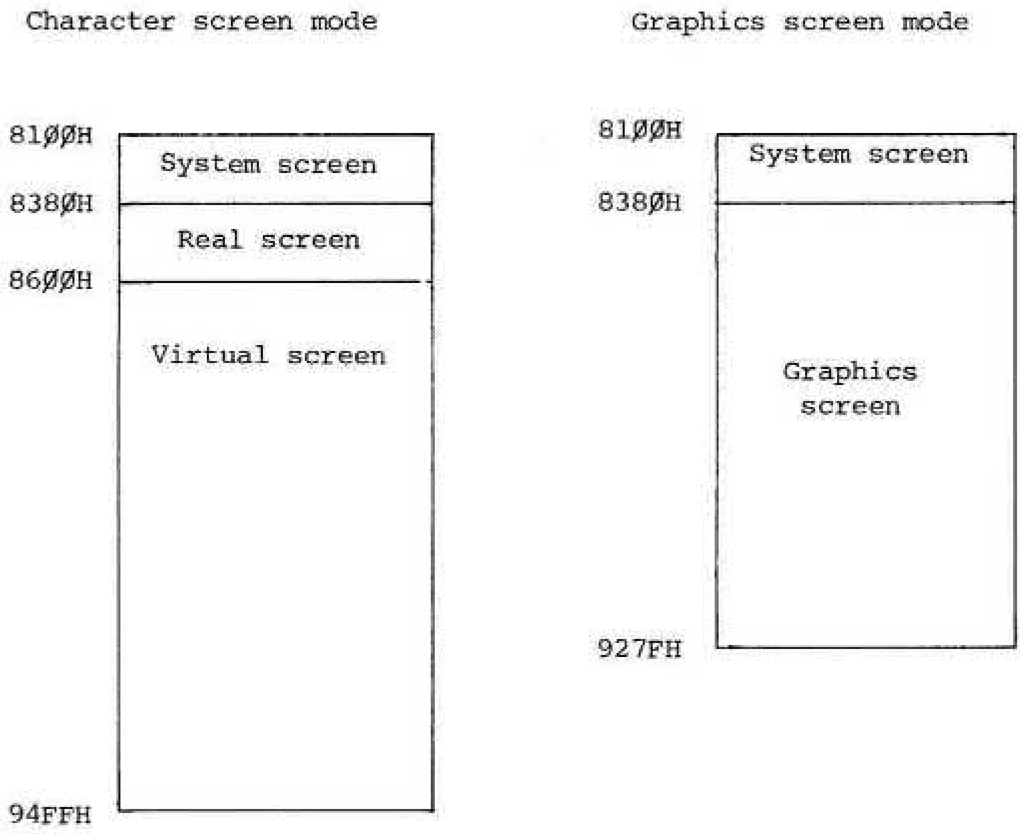


Japanese-language kanji :naracters are displayed in the graphics screen mode.

In the graphics mode, each single dot on the LCD is associated with a single bit in the graphics screen area in the RAM.

2) Screen configuration

The LCD screen configuration is shown below.



The system screen is used by the OS and not available to application programs. In the system screen, data is always displayed using character codes, independent of the screen mode. It has the same size as the LCD (80 x 8 = 640 bytes).

The real screen is as large as the 80 x 8 dot LCD and holds a portion of the virtual screen. Its image is displayed on the LCD by the LCD controller.

Since each dot on the LCD corresponds to a single data bit in the graphics screen and the LCD measures 480 dots by 64 dots, the LCD requires 480 dots x 64 dots ÷ 8 bits/byte = 3840 bytes of RAM. The graphics screen holds characters in bit image so that they may be displayed simultaneously with graphics data. See Chapter 6, "CONOUT" for further information.

3) Screen-related RAM areas

a) User defined characters area

The user can define characters in this area. It holds up to 32 user defined characters from 0E0H through 0FFH. User defined characters are defined using the ESC - 0E0H sequence via CONOUT.

b) Character screen area

The character screen area is used to store codes of characters to be displayed. In the screen configuration diagram in 2) above, all screen areas in the character screen mode and the system screen area in the graphics screen mode are used as the character screen area.

c) Graphics screen area

The graphics screen area is used to store data to be displayed in dot image. Its size is zero in the character screen mode.

The system buffer is used by the system when exchanging data with the MCT, serial communication interface, and Z80 CPU.

e) Character flash block definition area

The character flash block definition area contains character data to be flashed on the character screen. Three bytes are required to flash a single character (2-byte address and the character to be flashed) so a maximum of 40 characters can be flashed at a time in the character mode. Flashing is not available in the graphics screen mode (since the graphics screen holds character data in bit image form, it can use the graphics flash definition area that is described below). A character flash definition area can be defined by issuing the command code 31H to the slave CPU.

f) Graphics flash block definition area

The graphics flash block definition area contains graphics data to be flashed on the graphics screen. Three bytes are required to flash 8 consecutive dots

(2-byte address and 1-byte graphics data to be flashed) so a maximum of 144 dots can be flashed at a time in the graphics mode. This feature is available only in the graphics screen mode. Since the graphics screen holds graphics data in bit image form, it can use the graphics flash definition area that is described below. A graphics flash block definition area can be defined by issuing the command code 21H to the slave CPU.

g) Graphics user defined character definition area

The graphics user defined character definition area contains user defined character data for display on the graphics screen. This area can be used only in the graphics mode. A graphics user defined character definition area can be defined by issuing the command code 20H to the slave CPU.

h) User area

The user area (the remainder of the graphics user defined character definition area in the graphics screen mode) is not used by the slave CPU programs. The user may load programs into this area for execution.

i) System area

The system area is used by the slave CPU programs.

(3) Microcassette drive

The application program can perform various operations on the microcassette using commands described in Section 13.5. Since, however, files on the microcassette drive is controlled all by MTOS, an error would occur if an application program issued a microcassette command directly to the slave CPU while it was performing an I/O operation to the microcassette drove. No application program is therefore allowed to control the microcassette drive using the slave subsystem.

The application program may, however, exert direct control over the microcassette drive when playing back audio data tape (playback is not controlled by MTOS because no file operation is involved). The following precaution must be observed when driving a microcassette drive directly from an application program:

Precaution: Be sure to execute motor stop (4AH) and head off (42H) commands in this sequence before issuing an MCT-related command to the slave CPU.

To playback a microcassette tape, execute the following commands sequentially:

- Head On (command code 41H)
- Play (command code 48H)

(4) Serial communication interface

The MAPLE CP/M supports communication via a serial interface. Its slave CPU supports EPSP for controlling communication with external floppy disk drives.

(5) ROM capsule

The MAPLE can read data from the ROM capsules attached to the rear panel of the main unit. See Chapter 15 for the ROM memory map for the ROM capsules.

(6) Speaker

The MAPLE provides several functions to drive the speaker.

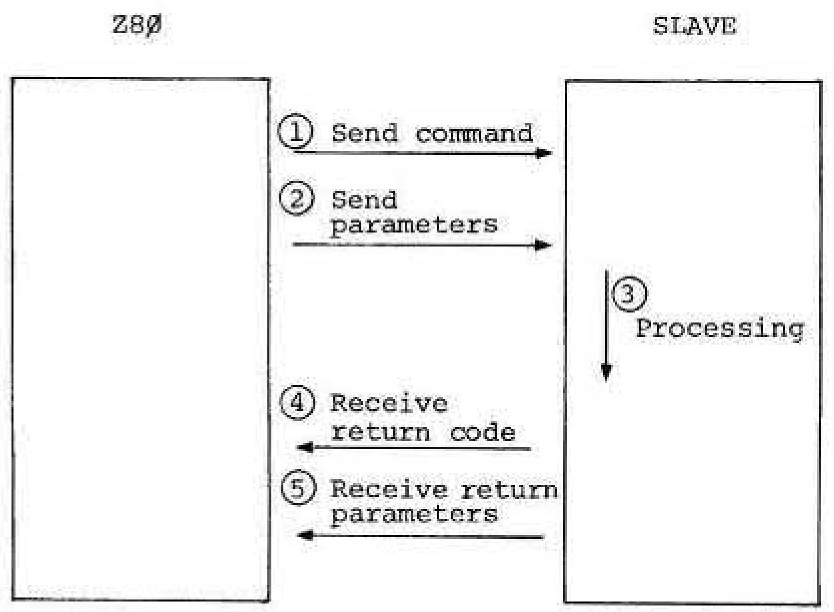
13.2 Data Backup

Since the MAPLE supports continue mode operations, the slave CPU must preserve the system status before power is turned off and restores it immediately after power is turned on again. To achieve this, the slave CPU provides the following functions:

- Battery backup of 6K RAM. The RAM data is always maintained whether MAPLE power is turned on or off.
- Saving and restoring the contents of CPU registers. These functions are used only by the OS POWER ON/OFF subroutines and not accessible to application programs (so they are not covered in this manual).

13.3 Z80-to-slave-CPU Communication Procedure

The Z80 and slave CPU communicate using the procedure described below.



The command (1) and return code (4) are 1 byte long and must always be issued. The presence and length of parameters (2 and 4) may differ depending on the command. The minimum parameter length is Ø, that is, no parameter. If the received return code contains a nonzero value (abnormal termination), the calling program will receive no return parameter.

Every sequence of steps 1 through 5 or 4 above must always be concluded; that is, no subsequent command must be issued before step 5 (or 4) is completed (the system will hang up if attempted).

The application program communicate with the slave CPU through the BIOS SLAVE function (WBOOT + 72H) (see Chapter 4, "BIOS Call" for details).

A command packet for turning on the speaker is shown below.

```
SPON:
          LD      A,0FFH
          LD      (SLVFLG),A
          LD      DE,072H
          LD      HL,(1)
          ADD     HL,DE
          LD      DE,PACK1  <------- Communication packet address
          JP      (HL)      <------- BIOS call (Call SLAVE.)

Communication
packet
PACKE1:   DW      SENDSV    <------- Send packet address
          DW      SENDLN    <------- Send packet length
          DW      RCVSV     <------- Receive packet address
          DW      RCVLNG    <------- Receive packet length

SENDSV:   DE      72H,80H   <------- Send packet (command + send
                                                  parameters)
SENDLN:   EQU     2         <------- Send command + parameters
RCVSV:    DS      1         <------- Receive packet
RCVLNG:   EQU     1         <------- Receive packet length
                                     (return code only)
```

Note: Two-byte address parameters must be sent to the slave CPU in higher-order-byte-first-sequenre. This is berause the slave CPU (6301) handle the 2-byte data the higher-order-byte-first as opposed to the Z80 CPU.

13.4 Slave CPU Commands

The rest of this chapter describes the slave CPU commands arranged by device.

How to interpret the command table

- The send packet length is the length of the command (one byte) plus its send parameters (SP1, SP2, ... SPn in 1)).
- The receive packet length is the length of the return code (one byte) plus receive parameters (RP1, RP2, ... RPn in 2)).
- The return code in 3) identifies the type of the status code returned by the slave CPU. The return code table is given at the end of this chapter.
- Commands are represented in hexadecimal notation. All parameters are treated as binary data.
- "Physical screen" refers to the "real screen" used in previous sections.

(1) RAM

This subsection explains the monitor program which controls program execution and RAM access.

Table 3-1 RAM commands

Code	Function
00	Read data
01	Write data
02	Execute routine

(1-1) Read Data (ØØ)

1) Send parameter

SP1: Address (high)

SP2: Address (low)

2) Receive parameter

RP1: Read data

3) Return code

RCDØØ

4) Function

Reads the data at the location designated by SP1 and SP2.

5) Note

An attempt to read data at a location lower than 8ØH will destroy the system.

(1-2) Write Data (Ø1)

1) Send parameter

SP1: Address (high)

SP2: Address (low)

SP3: Write data

SP4: Operation {1: AND, 2: OR, 3: XOR

Others: Store only

2) Receive parameter

None.

3) Return code

RCDØØ

4) Function

Performs the specified operation on the data and places the results at the address designated by SP1 and SP2.

(1-3) Execute Routine (Ø2)

1) Send parameter

SP1: Address (high)

SP2: Address (low)

2) Receive parameter

None.

3) Return code

?

4) Function

Transfers control to the address designated by SP1 and SP2. The following registers are loaded with as follows:

IX (97F4, 97F5)

A (97F3)

B (97F2)

C (97F1)

(2) Screen

This subsection describes the screen-related commands used to control the graphics and character screens.

Table 3-2 Screen Commands

Code	Function
10	Defines screen mode.
11	Turns on/off LCD.
12	Selects screen.
13	Reads screen pointer.
14	Sets screen pointer.
15	Defines number of lines.
16	Defines cursor mode.
17	Reads cursor position.
18	Defines cursor position.
19	Starts/Stops control block flashing.
1A	Clears screen.
1B	Reads character font.
20	Defines user graphics character.
21	Defines graphics screen block flashing data.
22	Draws character font on graphics screen.

23	Draws user defined graphics character on graphics screen.
24	Reads graphics screen data.
25	Displays data on graphics screen.
26	Moves graphics screen block.
27	Sets point.
28	Reads point.
29	Draws line.
30	Defines user character.
31	Defines character screen block flashing data.
32	Reads window pointer.
33	Sets window pointer.
34	Reads character screen data.
35	Displays data on character screen.
36	Moves character screen block.

(2-1) Define screen mode (10)

1) Send parameter

SP1 SP2: Character screen starting address

SP3 SP4: Graphics screen starting address

SP5 SP6: Character flash block starting address

SP7 SP8: Graphics flash block starting address

SP9 SP10: Graphics user defined character buffer starting address

SP11: Number of lines on character screen

SP12: User defined character starting code

SP13 SP14: Communication buffer address

SP15: LCD status

SP16: Screen status

2) Receive parameter

None.

3) Return code

RCD00

4) Function

Defines the configuration of the VRAM. The user cannot use this command since the VRAM configuration is defined by the OS as described on page 13-3. The OS display routine (CONOUT) will not function normally if the VRAM configuration is defined by the user.

(2-2) Turn On/Off LCD (11)

1) Send parameter

   SP1: ON/OFF switch (ØØ: OFF, Others: ON)

2) Receive parameter

   None.

3) Return code

   RCD00

4) Function

   Turns on or off the LCD display. This command only specifies whether data is to be displayed on the LCD and do not affect the contents of VRAM at all.

(2-3) Select Screen (12)

1) Send parameter

SP1: Screen select code (ØØ: Graphics screen,
Others: Character screen)

2) Receive parameter

None.

3) Return code

RCDØØ

4) Function

Selects the screen to be displayed on the physical screen. The screen is set to the window pointer position when the character screen is selected and set to the top when the graphics screen is selected.

(2-4) Read Screen Pointer (13)

1) Send parameter

   None.

2) Receive parameter

   RP1: Address (high)

   RP2: Address (low)

3) Return code

   RCD00

4) Function

   Reads the starting address of the VRAM area whose contents are currently displayed on the physical screen.

5) Note

   The LCD controller accesses VRAM only between addresses 8000H and 97FFH. Therefore, the highest order three bits of the pointer is insignificant and always set to 100.

(2-5) Set Screen Pointer (14)

1) Send parameter

SP1: Address (high)

SP2: Address (low)

2) Receive parameter

None.

3) Return code

RCDØØ

4) Function

Sets the physical screen starting address designated by SP1 and SP2.

The valid addresses are 8000H to 97FFH.

The LCD controller displays 640 bytes of data starting at the address pointed to by the pointer in the character screen mode. It displays 3840 bytes of data in the graphics mode.

(2-6) Define Number of Lines (15)

1) Send parameter

   SP1: ØØ: 8 lines

   Others: 7 lines

2) Receive parameter

   None.

3) Return code

   RCDØØ

4) Function

   Defines the number of lines to be displayed in the character screen mode. If this command is issued when the graphics screen mode is selected, the value defined by the command becomes valid when the screen mode is switched to character screen.

   8 or 7 lines refer to the number of lines to be displayed on the LCD. The OS always uses 8-line-per-screen mode. Characters are displayed with a wider spacing in 7-line mode than in 8-line mode.

(2-7) Define Cursor Mode (16)

1) Send parameter

SP1: Bit 7 - Bit 3: 0

Bit 2: Cursor font (0: Under line, 1: Block)

Bit 1: Cursor blink (0: OFF, 1: ON)

Bit 0: Cursor ON/OFF (0: OFF, 1: ON)

2) Receive parameter

None.

3) Return code

RCD00

4) Function

Defines the cursor mode to be used in the character screen mode according to the settings of bits 0 to 2 of SP1.
This command is valid only in the character screen mode. In the graphics mode, the cursor is always displayed in the underlined blink mode.

(2-8) Read Cursor Position (17)

1) Send parameter

None.

2) Receive parameter

RP1: Cursor X (Ø - 79)

RP2: Cursor Y {7-line mode (Ø - 6)

8-line mode (Ø - 7)

3) Return code

RCDØØ

4) Function

Reads the cursor position on the physical screen (in the character screen mode).

The upper left corner of the screen is taken as coordinates (Ø,Ø).

(2-9) Set Cursor Position (18)

1) Send parameter

SP1: Cursor X (Ø - 79)

SP2: Cursor Y {7-line mode (Ø - 6)
8-line mode (Ø - 7)

2) Receive parameter

None.

3) Return code

RCDØØ

4) Function

Sets the cursor position on the physical screen (in the character screen mode).
The cursor position must be within the maximum line and column numbers of the physical screen.

(2-1Ø) Start/Stop Control Block Flashing (19)

1) Send parameter

SP1: ØØ: Stop

Others: Start

(Ø1, ... FF)

The unit is 1ØØ msec.

2) Receive parameter

None.

3) Return code

RCDØØ

4) Function

Turns on and off block flashing on the current screen.

If no flash block is specified, this command does nothing even if block flashing is turned on.

The block to be flashed changes as the screen mode is changed.

Block flashing is specified by issuing a command 21H (in the graphics screen mode) or 31H (in the character screen mode).

(2-11) Clear Screen (1A)

1) Send parameter

SP1: Screen to be cleared

ØØ: Graphics screen

Others: Character screen

SP2: Clear code

SP3: Starting line

SP4: Number of lines to be cleared.

2) Receive parameter

None.

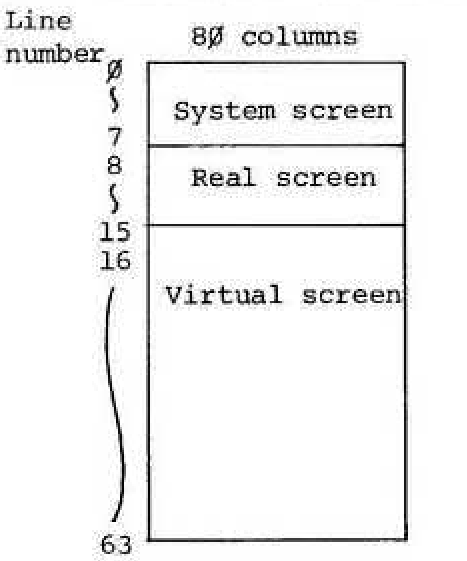
3) Return code

RCDØØ

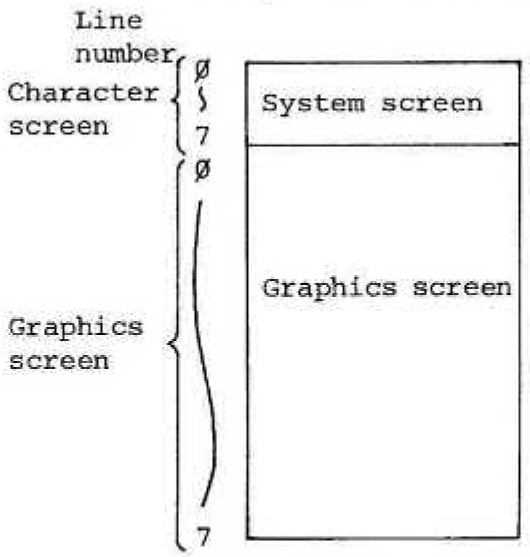
4) Function

Fills the specified number of lines (specified by SP4) starting at the line designated by SP3 on the screen area specified by PS1 with the code specified by SP2.
This command is invalid when the specified screen does not exist.
SP4 must not be set to 0. (Specifying 0 as SP4 value will destroy the system.)
The screen specified in SP1 refers to the screen shown in the memory map on page 13-3. The relationship between the line number and the screen type is shown below.

Character screen mode



Graphics screen mode



(2-12) Read Character Font (1B)

1) Send parameter

SP1: Character code

2) Receive parameter

RP1: Font data 1

RP2: Font data 2

RP3: Font data 3

RP4: Font data 4

RP5: Font data 5

RP6: Font data 6

RP7: Font data 7

RP8: Font data 8

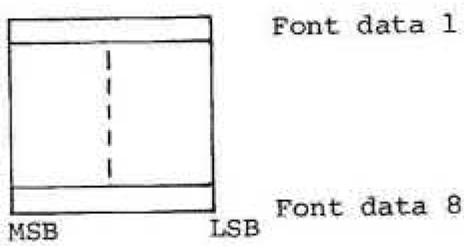
3) Return code

RCD00

4) Function

Reads the font of the specified character from the LCD controller or user defined character area.

5) Font image



Note: The correspondence between the character codes and fonts is shown in Chapter 20.

(2-13) Define User Defined Graphic Character (20)

1) Send parameter

SP1: Definition mode

00: Clear user defined character area

Others: User defined character code

SP2: Hight (size along x-axis)

SP3: Width (size along y-axis)

SP4: Data 1

.

.

SPn: Data n-3

2) Receive parameter

None.

3) Return codes

RCD00

RCD04

4) Function

Defines a graphics user defined character or clears the user defined character area. The definition code must not be 00.
Even if a user defined character is defined with a code which has already been assigned to another character, the character to be displayed on the graphics screen is the one

originally defined with that code (though the later definition is accepted.)

The sizes along x- and y-axes must be within the range x*y<=255. Specifying a size larger than that will cause an error. The definition will also be invalidated if too small x and y values are specified.

The user defined character block must be specified in byte units.

Data is placed in the area in row-first order.

Example:

x:3, y:4, Byte count: 12

Data 1	Data 2	Data 3
Data 4	Data 5	Data 6
Data 7	Data 8	Data 9
Data 10	Data 11	Data 12

(2-14) Define Graphics Screen Block Flashing Data (21)

1) Send parameter

SP1: Number of blocks

SP2: x-coordinate of the first block

SP3: y-coordinate of the first block

SP4: First block blink data

.

.

SPn-2: x-coordinate of the kth block

SPn-1: y-coordinate of the kth block

SPn: kth block blink data

2) Receive parameter

None.

3) Return codes

RCDØØ

RCDØ4

4) Function

Defines the coordinates of the blocks to flash and the blink data on the graphics screen. The block flashing data must not exceed the specified block. The maximum number of blocks that can be specified is 144.

(2-15) Draw Character Font on Graphics Screen (22)

1) Send parameter

   SP1: x-coordinate (high)

   SP2: x-coordinate (low)   (Ø - 479)

   SP3: y-coordinate   (Ø - 63)

   SP4: Character code   (Ø - FF)

2) Receive parameter

   None.

3) Return code

   RCDØØ

4) Function

   Reads the font corresponding to a character code specified in SP4 from the character generator and draws the font on the screen using the coordinates designated by SP1, SP2, and SP3 as the origin.

   Graphics coordinates must be specified in bits. The portion of the font extending beyond the right edge of the screen is entered into the screen from the left edge.

(2-16) Draw User Defined Character on Graphics Screen (23)

1) Send parameter

SP1: x-coordinate (0 - 59)

SP2: y-coordinate (0 - 63)

SP3: Graphics user defined character

2) Receive parameter

None.

3) Return codes

RCD00

RCD05

4) Function

Draws the block of the user defined character code specified in SP3 starting at the graphics screen coordinates specified in SP1 and SP2. Graphics user defined character can be defined by issuing a command 20H.

(2-17) Read Graphics Screen Data (24)

1) Send parameter

SP1: x-coordinate (Ø - 59)

SP2: y-coordinate (Ø - 63)

SP3: Byte count (Ø: 256, 1: 1, ... FF: 255)

2) Receive parameter

SP1: Data 1

.

.

SPn: Data n

3) Return codes

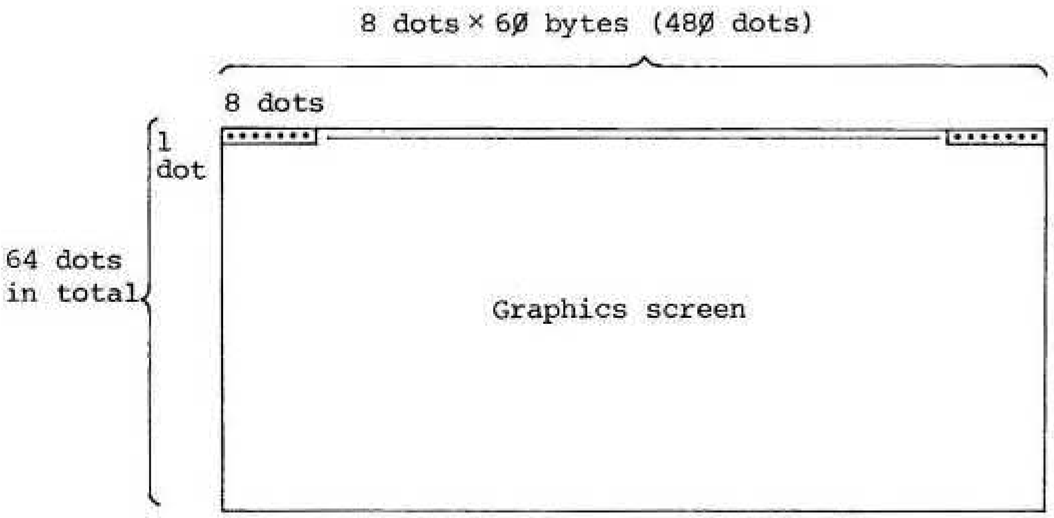
RCDØØ

RCDØ4

4) Function

Reads the number of bytes specified in SP3 in row-first order starting at the coordinates on the graphics screen designated by SP1 and SP2. Garbage data is returned for the portion of data which is specified in SP3 and which is out of the screen.

The number of receive parameters (n) is the same as that of data count specified in the third send parameter.


8 dots × 6Ø bytes (48Ø dots)
8 dots
1 dot
64 dots in total
Graphics screen

(2-18) Display Data on Graphics Screen (25)

1) Send parameter

SP1: x-coordinate (Ø - 59)

SP2: y-coordinate (Ø - 63)

SP3: Hight (size along x-axis)

SP4: Width (size along y-axis) }   x*y<=255

SP5: Operation   ØØ: Store   Ø1: AND

Ø2: OR   Ø3: EOR

SP6: Data 1

.

.

SPn: Data n-5

2) Receive parameter

None.

3) Return codes

RCDØØ

RCDØ4

4) Function

Stores the block of data specified in SP3 and SP4 at the specified coordinates on the graphics screen. Data is sent in row-first order.

Data 1   Data 2

Data 3   Data 4

Data 5   Data 6   Size: x = 2, y = 3

This command performs the specified operation on the write data and writes the result as the new data.

When store operation is specified, the command writes data as is, without masking with a mask pattern. Drawing is stopped when the write data overflows the screen.

Both height (x) and width (y) of the block must be 1 or larger. The product of x and y must be 255 or less.

(2-19) Move Graphics Screen Block (26)

1) Send parameter

SP1: Source x-coordinate (Ø - 59)

SP2: Source y-coordinate (Ø - 63)

SP3: Size along X-axis

SP4: Size along Y-axis

SP5: Destination x-coordinate (Ø - 59)

SP6: Destination y-coordinate (Ø - 63)

2) Receive parameter

None.

3) Return codes

RCDØØ

RCDØ4

4) Function

Moves the block designated by SP1, SP2, SP3, and SP4 on the graphics screen starting at the coordinates specified by SP5 and SP6.

(2-2Ø) Define Point (27)

1) Send parameter

SP1: x-coordinate (high) }
SP2: x-coordinate (low) } (Ø - 479)

SP3: y-coordinate (Ø -63)

SP4: Operation

Ø1: OFF   Ø2: ON   Ø3: Complement

2) Receive parameter

None.

3) Return codes

RCDØØ

RCDØ4

4) Function

Performs the specified operation on the dot at the specified graphic screen coordinates.

(2-21) Read Point (28)

1) Send parameter

SP1: x-coordinate (high) } (Ø - 479)

SP2: x-coordinate (low) }

SP3: y-coordinate (Ø - 63)

2) Receive parameter

RP1: ØØ: off Others: ON

3) Return codes

RCDØØ

RCDØ4

4) Function

Reads the state of the dot at the specified graphics screen coordinates.

(2-22) Draw Line (29)

1) Send parameter

SP1: Starting x-coordinate (high)	}	(0 - 479)
SP2: Starting x-coordinate (low)		
SP3: Starting y-coordinate (high)	}	(0 - 63)
SP4: Starting y-coordinate (low)		
SP5: Ending x-coordinate (high)	}	(0 - 479)
SP6: Ending x-coordinate (low)		
SP7: Ending y-coordinate (high)	}	(0 - 63)
SP8: Ending y-coordinate (low)		
SP9: Operation vector (high)	}	0: No operation
SP10: Operation vector (low)		1: Operation

SP1: Point mode 01: OFF 02: ON 03: Complement

2) Receive parameter

None.

3) Return code

RCD00

4) Function

Draws a line on the graphics screen between the starting and ending coordinates. The points are displayed in the point mode only when the MSB of the operation vector is set to 1. The operation vector is rotated to the left at setting every single dots.

The top left corner of the screen is set to (0, 0). The horizontal and vertical axes are defined as x-axis and y-axis, respectively. Data at the points outside the screen is not displayed.

(2-23) User Defined Character (30)

1) Send parameter

SP1: Character code (E0H-FFH)

SP2: Data 1

.

.

SP9: Data 8

2) Receive parameter

None.

3) Return codes

RCD00

RCD06

4) Function

Defines an user defined character in the user defined character area. Invalid codes not in the range 0E0H to 0FFH are ignored.

"A", for example, is defined with the following data:

	bit 7	6	5	4	3	2	1	bit Ø
Data 1	Ø	Ø	Ø	Ø	1	1	Ø	Ø
Data 2	Ø	Ø	Ø	1	Ø	Ø	1	Ø
Data 3	Ø	Ø	1	Ø	Ø	Ø	Ø	1
Data 4	Ø	Ø	1	Ø	Ø	Ø	Ø	1
Data 5	Ø	Ø	1	1	1	1	1	1
Data 6	Ø	Ø	1	Ø	Ø	Ø	Ø	1
Data 7	Ø	Ø	1	Ø	Ø	Ø	Ø	1
Data 8	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø

(2-24) Define Character Screen Block Flashing Data (31)

1) Send parameter

   SP1: Number of blocks

   SP2: x-coordinate of the first block (0 - 79)

   SP3: y-coordinate of the first block (0 - 63)

   SP4: First block blinking data

   .

   .

   SPn-2: x-coordinate of the kth block

   SPn-1: y-coordinate of the kth block

   SPn: kth block blinking data

2) Receive parameter

   None.

3) Return codes

   RCD00

   RCD04

4) Function

   Specifies the coordinates of the block to flash and the blink data on the character screen. Specifying coordinates outside the screen will make all definitions in this command invalid. Up to 40 blocks can be defined. All blocks will be cleared when the screen mode is altered.

(2-25) Read window pointer (32)

1) Send parameter

None.

2) Receive parameter

RP1: x-coordinate (Ø - 79)

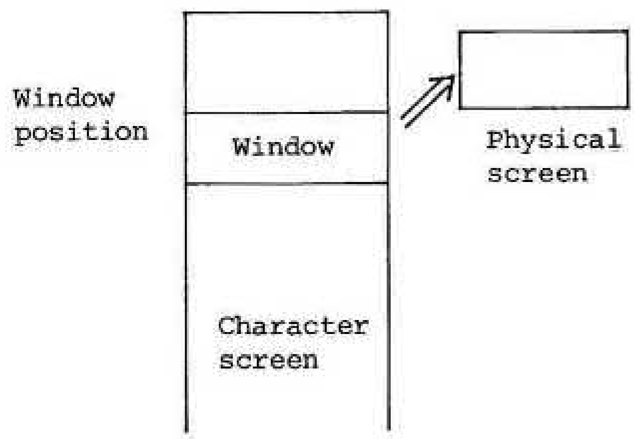
RP2: y-coordinate (Ø - 63)

3) Return code

RCDØØ

4) Function

Reads the character screen coordinates at which display is to begin.



(2-26) Set Window Pointer (33)

1) Send parameter

   SP1: x-coordinate (Ø - 79)

   SP2: y-coordinate (Ø - 63)

2) Receive parameter

   None.

3) Return code

   RCDØØ

4) Function

   Defines the window position on the character screen. This command is valid if issued in the graphics screen mode (it will be executed when the screen is switched to character mode).

(2-27) Read Character Screen Data (34)

1) Send parameter

SP1: x-coordinate (Ø - 79)

SP2: y-coordinate (Ø - 63)

SP3: Byte count (0:256, 1:1, ... FF:255)

2) Receive parameter

RP1: Data 1

.

.

RPn: Data n

3) Return code

RCDØØ

4) Function

Reads the specified number of data bytes from the character screen in row-first order. If the parameters are specified to read data beyond the character screen area, data other than display data is read.

The number of receive parameters (n) is the same as the number specified in the third send parameter.

(2-28) Display Data on Character Screen (35)

1) Send parameter

SP1: Starting x-coordinate (Ø - 79)

SP2: Starting y-coordinate (Ø - 63)

SP3: Byte count (1: 1, ... FF: 255)

SP4: Data 1

.

.

SPn: Data n-3

2) Receive parameter

None.

3) Return code

RCDØØ

4) Function

Displays the specified data in row-first order on the character screen starting at the specified coordinates. The portion of data not fitting in the screen is ignored.

Byte count must not be set to Ø.

The relationship between the y-coordinate values and screen types is as follows:

Ø - 7: System screen

8 - 15: Real screen

16 - 63: Virtual screen

(2-29) Move Character Screen Block (36)

1) Send parameter

   SP1: Source x-coordinate (Ø - 79)

   SP2: Source y-coordinate (Ø - 63)

   SP3: Hight (size along x-axis)

   SP4: Width (size along y-axis)

   SP5: Destination x-coordinate (Ø - 79)

   SP6: Destination y-coordinate (Ø - 63)

2) Receive parameter

   None.

3) Return codes

   RCDØØ

   RCDØ4

4) Function

   Moves the block specified by SP1, SP2, SP3, and SP4 on the character screen from the coordinates designated by SP5 and SP6.

(3) Microcassette

This subsection describes the commands for driving the microcassette drive.

Table 3-3 Microcassette commands

Code	Command
40	Read microcassette status
41	Head on
42	Head off
43	Rewind n counts
44	Fast forward n counts
45	Rewind
46	Fast forward
47	Slow rewind
48	Play
49	Record
4A	Stop
4B	Read write protect pin
4C	Read counter
4D	Set counter
51	Write data and non-stop
52	Write data and stop
53	Read data and non-stop

54	Read data and stop
55	Set write protect area
56	pointer. Reset write protect area pointer

(3-1) Read Microcassette Status (40)

1) Send parameter

None.

2) Receive parameter

RP1: Microcassette status

Bit 7:	Head position	(0: OFF 1: ON)
Bit 6:	Motor	(0: Stop 1: Move)
Bit 5:	Rewind	(0: No 1: Wind)
Bit 4:	FF	(0: No 1: FF)
Bit 3:	Play	(0: No 1: Play)
Bit 2:	Record	(0: No 1: Record)
Bit 1:		
Bit 0:	Write protect area set flag	(0: Reset 1: Set)

3) Return code

RCD00

4) Function

Reads the status of a microcassette drive.

The write protect area setting flag (bit 0) is set to 1 when a command 55H is executed and set to 0 (reset) when a command 56H is executed.

(3-2) Head On (41)

1) Send parameter

None.

2) Receive parameter

None.

3) Return codes

RCD00

RCD07

4) Function

Turns the read/write head on.

This command must be issued while the microcassette drive is not in motion.

(3-3) Head Off (42)

1) Send parameter

None.

2) Receive parameter

None.

3) Return codes

RCD00

RCD07

4) Function

Turns the read/write head off.

This command must be issued while the microcassette drive is not in motion.

(3-4) Rewind n counts (43)

1) Send parameter

SP1: Counter value (high-order)

SP2: Counter value (low-order)

2) Receive parameter

None.

3) Return codes

RCD00

RCD07

RCD08

4) Function

Moves tape backward the number of tape count specified in SP1 and SP2.

5) Note

If tape is rewound 100 tape counts from count 1000, for example, the tape at position 900 will come under the read/write head.
The head is automatically turned off in the rewind mode.

(3-5) Fast Foward n Counts (44)

1) Send parameter

SP1: Counter value (high-order)

SP2: Counter value (low-order)

2) Receive parameter

None.

3) Return codes

RCD00

RCD07

RCD08

4) Function

Winds the tape forward by the counts specified by SP1 and SP2.

(3-6) Rewind (45)

1) Send parameter

None.

2) Receive parameter

None.

3) Return codes

RCDØØ

RCDØ7

4) Function

Rotates the motor in the reverse direction (rewind).

(3-7) Fast Foward (46)

1) Send parameter

None.

2) Receive parameter

None.

3) Return code

RCDØØ

4) Function

Rotates the motor in the forward direction.

(3-8) Slow Rewind (47)

1) Send parameter

   None.

2) Receive parameter

   None.

3) Return codes

   RCDØØ

   RCDØ7

4) Function

   Rotates the motor in the reverse direction at a low speed.

(3-9) Play (48)

1) Send parameter

None.

2) Receive parameter

None.

3) Return code

RCDØØ

4) Function

Rotates the motor in the play mode.

The read signal is placed on the read line if the microcassette drive is in the head on state.

(3-10) Record (49)

1) Send parameter

None.

2) Receive parameter

None.

3) Return code

RCD00

4) Function

Rotates the motor in the record mode. Data on the tape will be erased if the read/write head is on.

(3-11) Stop (4A)

1) Send parameter

None.

2) Receive parameter

None.

3) Return code

RCDØØ

4) Function

Stops the motor to rotate. Head position does not move.

(3-12) Read Write Protect Pin (4B)

1) Send parameter

None.

2) Receive parameter

RP1: ØØ: Protected

Others: Not protected

3) Return code

RCDØØ

4) Function

Used to check whether the current microcassette tape is write protected.

(3-13) Read Counter (4C)

1) Send parameter

None.

2) Receive parameter

RP1: Counter value (high-order)

RP2: Counter value (low-order)

3) Return code

RCDØØ

4) Function

Reads the current value of the 16-bit counter.

(3-14) Set Counter (4D)

1) Send parameter

SP1: Counter value (high-order)

SP2: Counter value (low-order)

2) Receive parameter

None.

3) Return code

RCD00

4) Function

Sets the counter.

(3-16) Write Data and Non-stop (51)

1) Send parameter

SP1: Data length (high-order) } 0000:65536,

SP2: Data length (low-order) } 0001:1, ...

SP3: Pointer to block ID number

SP4: Data 1

.

.

SPn: Data n-3

2) Receive parameter

RP1: Block end counter (high-order)

RP2: Block end counter (low-order)

3) Return codes

RCD00

RCD07

RCD08

RCD09

4) Function

Writes the specified number of data bytes onto tape. A 00H in SP3 identifies the first block that is written for the current block and a 01H the second write for the block. This byte is automatically incremented by the slave CPU during processing. The issuing program must set this byte in the send data to 0FFH.

(3-17) Write Data and Stop (52)

1) Send parameter

   SP1: Data length (high-order)

   SP2: Data length (low-order)

   SP3: Pointer to block ID number

   SP4: Data 1

   .

   .

   SPn: Data n-3

2) Receive parameter

   RP1: Block end counter (high-order)

   RP2: Block end counter (low-order)

3) Return codes

   RCDØØ

   RCDØ7

   RCDØ8

   RCDØ9

4) Function

   This command performs the same function as Write Data and Non-stop except that it stops the tape after writing data.

(3-18) Read Data and Non-stop (53)

1) Send parameter

SP1: Data length (high-order)

SP2: Data length (low-order)

SP3: Block ID code

2) Receive parameter

RP1: Block start counter (high-order)*

RP2: Block start counter (low-order)

RP3: Data 1

.

.

RPn: Data n-2

3) Return codes

RCD00

RCD07

RCD08

RCD10

RCD11

RCD11-1

4) Function

Reads the specified bytes of data from tape. If an error is found in a block, this command returns a return codes RP1 and RP2, and starts reading the next block. If the specified block is read normally, the command terminates reading of the block without stopping the motor.

The block ID code is a control code which is used to identify the beginning of a block.

No check is made on the block ID if 3FH ('?') is specified in SP3.

*: Counter value after preamble is read.

(3-19) Read Data and Stop (54)

1) Send parameter

SP1: Data length (high-order)

SP2: Data length (low-order)

SP3: Block ID code

2) Receive parameter

RP1: Block start counter (high-order)*

RP2: Block start counter (low-order)

RP3: Data 1

.

.

RPn: Data n

3) Return codes

RCDØØ

RCDØ7

RCDØ8

RCD1Ø

RCD11

RCD11-1

4) Function

Reads the specified bytes of data from tape. This command has the same functions as Read Data and Non-stop except that it stops the motor after reading the specified block.

(3-2Ø) Set Write Protect Area Pointer (55)

1) Send parameter

SP1: Counter value (high-order) } Protect area pointer
SP2: Counter value (low-order)

2) Receive parameter

None.

3) Return code

RCDØØ

4) Function

Decrements the write protect pointer by 1 every time the tape counter increments by 1 at each read or write operation and terminates either read or write when the pointer reaches Ø.
This command is used to stop processing on a cassette at a desired count. MTOS uses this function to erase a length of tape specified in the tape count parameter.
Whether processing has been stopped or not can be identified by examining bit 6 of the status information returned by command 4ØH. If this bit is Ø, the motor has been stopped (that means processing has been terminated).
Whether the pointer is set or not can also be

identified by checking bit 0 of the status information returned by command 40H.

(3-21) Reset Write Protect Area Pointer (56)

1) Send parameter

   None.

2) Receive parameter

   None.

3) Return code

   RCDØØ

4) Function

   Makes the value of the write protect area pointer invalid. After this command, the user can write on the tape without considering the write protect area pointer value.

(4) Serial I/O and serial communication

This subsection describes the commands for serial I/O and serial communication. Refer to Chapter 15 for the serial communications protocol.

Table 3-4 Serial I/O, serial communications commands

Code	Command
60	Read serial I/O port status
61	Set serial port bit rate
62	Serial input
63	Serial output
64	Send with header
65	Receive data

(4-1) Read Serial I/O Status (60)

1) Send parameter

None.

2) Receive parameter

RP1: Serial I/O status

Bit 7: Receive register status
(0: Empty 1: Full)

Bit 6: Overrun framing error
(0: No 1: Error)

Bit 5: Transmit register status
(0: Full 1: Empty)

Bit 4: Control out (0: Low 1: High)

Bit 3: Control in (0: Low 1: High)

3) Return code

RCD00

4) Function

Reads the serial I/O status value.

(4-2) Set Serial Port Bit Rate (61)

1) Send parameter

SP1: Specifies the bit rate, general purpose input port check bit, and general purpose output port level.

Bits 0 and 1: Sets bit rate.

	Bit 1	Bit Ø
384ØØ	Ø	Ø
48ØØ	Ø	1
6ØØ	1	Ø
15Ø	1	1

Bit 5: General purpose output level.

2) Receive parameter

None.

3) Return code

RCDØØ

4) Function

Sets the serial port bit rate and defines the level of the general purpose output port.

(4-3) Serial Input (62)

1) Send parameter

None.

2) Receive parameter

RP1: Data

3) Return codes

RCD00

RCD13

4) Function

Reads one character from the serial port.

(4-4) Serial Output (63)

1) Send parameter

   SP1: Send data

2) Receive parameter

   None.

3) Return code

   RCDØØ

4) Function

   Sends one character to the serial port.

(4-5) Send Data with Header (64)

1) Send parameter

SP1: Receive data flag

(ØØ: Receive no data after sending.

Ø1: Receive data after sending.)

SP2: FMT

SP3: DID

SP4: SID = 22H

SP5: FNC

SP6: SI2

SP7: Data 1

.

.

SPn+7 : Data n

2) Receive parameter

(Valid only when SP1 ≧ 1.)

RP1: Header information (00: Header / 01: No header)

When SP1=00

FMT

DID

SID

FNC

SIZ

RP2: Data 1

.

.

RPk: Data n

3) Return codes

RCD00

RCD12

RCD13

RCD14

4) Function

Sends data with a header to the serial port according to the EPSP protocol. The command also receives data with a header if the receive data flag is set to 1. It terminates processing immediately when an error is detected.

(4-6) Receive Data with Header (65)

1) Send parameter

None.

2) Receive parameter

RP1: Header information (00: Header / 01: No header)

RP2: FMT
RP3: DID
RP4: SID
RP5: FNC
RP6: SIZ
RP7: Data 1

(RP2 – RP7: Valid only when RP1 = 00)

.

.

RPn+5: Data n

3) Return codes

RCD00

RCD12

RCD13

RCD14

4) Function

Receives data with a header from the serial port. FMT through SIZ are omitted if the header information is 01.

(5) ROM and speaker

This subsection deals with the commands for PROM capsules and speakers.

Table 3-5 PROM and speaker commands

Code	Command
70	Turn on/off PROM capsule power
71	Read PROM data
72	Turn on/off speaker power
73	Beep
74	Melody

(5-1) Turn On/Off PROM capsule power (70)

1) Send parameter

SP1: ØØ: OFF

Others: ON

2) Receive parameter

None.

3) Return code

RCDØØ

4) Function

Turns on or off ROM capsule power according to the parameter specification.

5) Note:

It will take one second after a power-on before the ROM capsule is ready.

(5-2) Read Data (71)

1) Send parameter

SP1: Power on flag

(ØØ: OFF Others: ON)

SP2: Data address (high-order)

SP3: Data address (low-order)

SP4: Data count (Ø: 256, 1: 1, ... FF: 255)

2) Receive parameter

(Valid only when Return code = ØØ.)

RP1: Data 1

.

.

RPn: Data n

3) Return code

RCDØØ

4) Function

Reads the specified bytes of data starting at the specified data address. Cartridge #0 is selected when the MSB of the data address is 0. Cartridge #1 is selected when the MSB is 1. When the power off flag is set to ØØ, this command turns off ROM capsule power after reading the data. ROM capsule power must be turned on before this command is executed.

(5-3) Turn On or Off Speaker Power (72)

1) Send parameter

SP1: Power on/off switch

Bit 7 Ø: OFF 1: ON

2) Receive parameter

None.

3) Return code

RCDØØ

4) Function

Turns on or off the power to the speaker amplifier.

(5-4) Beep (73)

1) Send parameter

SP1: Period (high-order)

SP2: Period (low-order)

SP3: Duration (in 100 msec units)

2) Receive parameter

None

3) Return code

RCD00

4) Function

Sounds the speaker at the specified frequency (reciprocal of period) for the specified length of time. The unit of period is 3.2 µsec.

(5-5) Melody (74)

1) Send parameter

SP1: Repeating count

(Ø: 256, 1: 1, ... FF: 255)

SP2: Data address (high-order)

SP3: Data address (low-order)

2) Receive parameter

None.

3) Return code

RCDØØ

4) Function

Sounds the speaker according to the data read from the specified address.

Data format

Duration 1 (1)

Period 1 (2)

.

.

Duration n (1)

Period n (2)

ØØ

Return Codes (in decimal)

1) RCDØØ (SYS)

Code: ØØ

Explanation: Normal termination.

2) RCDØ1 (SYS)

Code: Ø1

Explanation: Break acknowledged.

3) RCDØ2 (SYS)

Code: Ø2

Explanation: Command error.

A command code (ØØH - 7FH) not defined by the system was issued.

4) RCDØ3 (SYS)

Code: Ø3

Explanation: Communications error.

A command was issued while sending or receiving data or sending another command.

5) RCDØ4 (LCD)

Code: 11

Explanation: Invalid size specification.

The specified data did not fit in the screen.

6) RCD05 (LCD)

Code: 12

Explanation: Undefined graphics user defined character.

8) RCD06 (LCD)

Code: 13

Explanation: Invalid user defined character

An attempt was made to specify a code other than the codes under which user defined characters are defined.

9) RCD07 (MCT)

Code: 41

Explanation: Head error.

The head did not function normally.

10) RCD08 (MCT)

Code: 42

Explanation: Tape stopped during processing.

11) RCDØ9 (MCT)

Code: 43

Explanation: Write protect error.

An attempt was made to write on the tape having no write protect tab.

12) RCD1Ø (MCT)

Code: 44

Explanation: Data error.

A pulse of an invalid width was received and the logical state of the pulse (1 or Ø) could not be determined.

13) RCD11 (MCT)

Code: 45

Explanation: CRC error.

14) RCD12 (ESPS)

Code: 61

Explanation: Linking unsuccessful.

15) RCD13 (ESPS)

Code: 62

Explanation: Communication error.

An overrun framing error occurred.

16) RCD14 (ESPS)

Code: 63

Explanation: Time over.

17) RCD15 (BEEP)

Code: 71

Explanation:

A BEEP or MELODY command was issued before the execution of the preceding BEEP or MELODY command was completed.

18) RCD11-1 (MCT)

Code: 46

Explanation: Block mode error.

A block with an invalid block identifier was read.

Chapter 15 I/O and Peripheral Devices

This chapter discusses the following tops:

1. I/O address space
2. Physical file structure
3. EPSP protocol
4. DIP switches

15.1 I/O Address Space

The MAPLE I/O address space listed below.

I/O address	Read	Write
00H	ICRL (Input Capture Register Low)	CTLR1 (Control Register 1)
01H	ICRH (Input Capture Register High)	CMDR (Command Register)
02H	ICRL.B (ICRL Bar code Trigger)	CTLR2 (Control Register 2)
03H	ICRH.B (ICRH Bar code Trigger)	
04H	ISR (Interrupt Status Register)	IER (Interrupt Enable Register)
05H	STR (Status Register)	
06H	SIOR (Serial I/O register)	SIOR (Serial I/O register)
0CH	8251 Data Read	8251 Data Write
0DH	8251 Status Read	8251 Command Write
0EH	SED 1320 PSR	SED 1320 PDIR
0FH	SED 1320 PDOR	SED 1320 PDIR

I/O addresses between 00H and 7FH excluding the above addresses are not used.

I/O addresses 80H through 0FFH are used to access optional units over the system bus. Since addresses 80H through 0DFH are assigned to EPSON optional units addresses 0E0H through 0FFH must be used for user-supplied options.

Currently used I/O addresses

I/O address	Optional unit
8ØH	Intelligent RAM disk
81H	
82H	
83H	
84H	Direct modem
85H	
86H	
87H	
88H	Japanese-language processor
89H	
8AH	
8BH	
8CH	
8DH	
8EH	
8FH	

I/O address	Optional unit
9ØH	Nonintelligent RAM disk
91H	
92H	
93H	
94H	
95H	
96H	
97H	
98H	
99H	
9AH	
9BH	
9CH	
9DH	
9EH	
9FH	

I/O address	Optional unit
AØH	Synchronous communication unit
A1H	
A2H	
A3H	
A4H	
A5H	
A6H	
A7H	

See Chapter 16, "Extension Units" for use of I/O addresses.

(1) I/O address ØØH

[Read] ICRL

The CPU reads the lower 8 bits from the current FRC (16-bit counter running at 614.4 KHz clock) through this I/O port address. Since the contents of the FRC are loaded into port addresses ØØH and Ø1H immediately once this port is read, the higher 8 bits from the FRC can also read from address Ø1H immediately.

Addresses ØØH and Ø1H must be read in that order.

[Write] CTLR1

CTLR1 bits are assigned as follows:

Bit	Name	Function
7	BRG3	Sets the clock rate for the 8251 (see section 12.2).
6	BRG2	
5	BRG1	
4	BRG0	
3	SWBCD	Indicates the state of the bar code bar code connector power switch (5V). 1: ON, 0: OFF
2	BCD1	Sets the bar code reader interrupt trigger (see section 10.7)
1	BCD0	
0	BANK	Specifies the memory bank. 0: BANK0 0000H - 07FFFH = ROM 8000H - 0FFFFH = RAM 1: BANK1 0000H - 0FFFFH = RAM

Any data to be written into this I/O address must also be saved into work area labeled CTLR1.

```
LD    A, (CTLR1)
```

Set necessary bits of A reg. to 1.

```
LD    (CTLR1), A
OUT   (00H), A
```

CTLR1 --- Overseas version = ØFØBØH

Japanese-language version =ØED9ØH

(2) I/O address Ø1H

[Read] ICRH

The CPU reads the higher 8 bits from the current FRC through this port address. The contents of the FRC is latched immediately when address ØØH is read. Consequently, the contents of ØØH and Ø1H must be read in that order.

[Write] CMDR

CMDR bit assignments are as follows:

Bit	Name	Function
7 6 5 4 3		Unused Always set to 0.
2	RESOVF	1: Resets OVF interrupt INTR signal generated by FRC overflow. 0: Does nothing. The interrupt INTR signal must be reset by the OVF interrupt processing routine before OVF interrupts are to be enabled.

1	RESRDYSIO	1: Resets RDYSIO signal used for communicating with the 7508 (the signal indicates whether the 7508 is ready). 0: Does nothing. See Chapter 11, "7508 CPU" for the use of this bit.
0	SETRDYSIO	1: Sets RDYSIO signal used for communicating with the 7508. 0: Does nothing. This bit is not used by applications.

Set only the necessary bit (bit 1 or 2) to 1 before sending data to this I/O address.

(3) I/O address Ø2H

[Read] ICRL.B

This address contains the lower 8 bits from the FRC latched on a transition in the state of the signal from the bar code reader (positive or negative trigger). A transition in the signal state can be recognized through the ICF interrupt processing routine or by checking I/O address Ø4H, bit 3 (INT3 signal).

The higher 8 bits can be read from I/O address Ø3H.

I/O addresses Ø2H and Ø3H must be read in that order.

[Write] CTLR2

CTLR2 bit assignments are as follows:

Bit	Name	Function
7 6		Unused
5	AUX	1: Specifies that the 8251 is to be connected to the RS-232C connector. 0: Specifies that system bus lines TxDE and *RxDE are to be used to control 8251 handshaking. This bit is set to 0 immediately after the RESET switch is pressed.

Bit	Name	Function
4	INHRS	Used to prevent generation of garbage data when power to the RS-232C drivers is turned on or off. Set this bit to 1 when turning on or off the driver power.
3	SWRS	1: Indicates that RS-232C power ($\pm$8 V) is on. 0: Indicates that RS-232C power ($\pm$8 V) if off.
2	LED2	1: Indicates that keyboard LED2 is set to on. 0: Indicates that keyboard LED2 is set to off.
1	LED1	1: Indicates that keyboard LED1 is set on. 0: Indicates that keyboard LED1 is set to off.
0	LED0	1: Indicates that keyboard LED0 is set to on. 0: Indicates that keyboard LED0 is set to off.

Write data into this I/O address using the following procedure:

```
LD    A, (CTLR2)
```

Set necessary bits of A reg. to 1.

```
LD    (CTLR2), A
OUT   (02H), A
```

CTLR2 --- Overseas version = 0F0B2H

Japanese-language version =0ED92H

(4) I/O address Ø3H

[Read] ICRH.B

This address contains the higher 8 bits from the FRC latched by a transition in the state of the signal from the bar code reader (positive or negative trigger).
Transition in the signal state can be recognized through the ICF interrupt processing routine or by checking I/O address Ø4H, bit 3 (INT3 signal).
The INT3 signal (interrupt signal from the bar code reader) is reset when this I/O address is read.
Addresses Ø2H and Ø3H must be read in that order.

[Write]

None.

(5) I/O address 04H

[Read] ISR

The bits in I/O address 04H indicate the associated interrupt status as shown below:

Bit	Name	Function
7		Unused
6		
5	INT5 (EXT)	Indicates the (EXT) external interrupt (system bus external interrupt) status.
4	INT4 (OVF)	Indicates the status of the OVF interrupt caused by FRC overflow. This bit is reset by setting I/O address 01H, bit2.
3	INT3 (ICF)	Indicates the bar code reader interrupt status. This bit is reset by when I/O address 03H is read.
2	INT2 (CD)	Complement of RS-232C CD signal. (When CD is set low, INT2 is set high, generating a CD interrupt.)

1	INT1 (8251)	Indicates the status of the 8251 interrupt generated when RxRDY is set. This bit is reset when receive data is read from the 8251.
0	INT0 (7508)	Indicates the 7508 interrupt status. This bit is reset when the 7508 status is read.

Each of the above statuses can be read if the corresponding interrupt is masked.

[Write] IER

The IER bits enable or disable the corresponding interrupt. All interrupts are disabled when the RESET switch is pressed.

Bit	Name	Function	
7		Unused	
6			
5	IER5	EXT interrupts	1: Enabled 0: Disabled
4	IER4	OVF interrupts	
3	IER3	ICF interrupts	
2	IER2	CD interrupts	
1	IER1	8251 interrupts	
0	IER0	7508 interrupts	

Write data into this I/O address using the following procedure:

```
LD    A, (IER)
```

Set necessary bits of A reg. to 1.

```
LD    (IER), A
OUT   (04H), A

IER --- Overseas version = 0F0B3H
        Japanese-language version =0ED93H
```

(6) I/O address 05H

[Read] STR

The bits in I/O address 05H indicate the I/O status as follows:

Bit	Name	Function
7		Unused
6		
5		
4		
3	RDYSIO	Indicates the state of the control signal for the serial bus that serves as an interface to the 7508. 1: 7508 accessible 0: 7508 inaccessible See Chapter 11, "7508 CPU" for to to access the 7508.
2	RDY	Indicates the state of the RDY input line from the 7508. This line is not used.
1	BRDT	Indicates the state of the data input signal from the bar code reader.

Bit	Name	Function
0	BANK	Indicates the current BANK status. 0: BANK0 0000H - 7FFFH = ROM 8000H - 0FFFFH = RAM 1: BANK1 0000H - 0FFFFH = RAM

(7) I/O address Ø6H

[Read]

The Z8Ø CPU reads this I/O address when receiving data from the 75Ø8.

[Write]

The Z8Ø CPU reads this I/O address when sending a command or data to the 75Ø8.

See Chapter 11, "75Ø8 CPU" for how to access the 75Ø8.

(8) I/O address ØCH

[Read]

The Z8Ø CPU reads this I/O address when receiving RS-232C receive data from the 8251.

[Write]

The Z8Ø CPU reads this I/O address when sending RS-232C send data to the 75Ø8.

(9) I/O address ØDH

[Read]

The Z8Ø CPU reads this I/O address when reading the 8251 status.

[Write]

The Z8Ø CPU reads this I/O address when sending a command to the 8251.

See Chapter 12, "Using 8251" or consult technical reference manuals on 8251 for I/O addresses ØCH and ØDH.

(1Ø) I/O address ØEH

[Read]

The Z8Ø CPU reads this I/O address when reading the 63Ø1 status.

[Write]

The Z8Ø CPU reads this I/O address when sending data to the 63Ø1.

(11) I/O address ØFH

[Read]

The Z8Ø CPU reads this I/O address when receiving data from the 63Ø1.

[Write]

The Z8Ø CPU reads this I/O address when sending a command to the 63Ø1.

The user cannot read I/O addresses ØEH and ØFH directly.

Use the slave BIOS call (WBOOT + 72H) to access the 63Ø1.

15.2 Physical File Structure

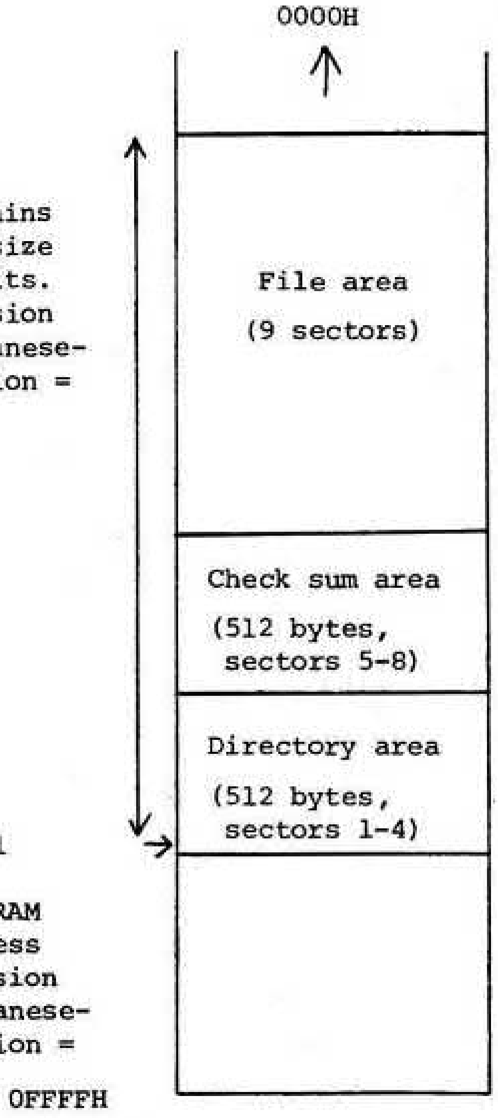
This section describes the structure of the MAPLE files stored on the MAPLE drives. The MAPLE drives use various types of storage media. The storage drives and media are summarized below.

1. Drive A: Internal RAM disk
   See Chapter 16, "Extension Units" for the extension unit RAM disk which is also assigned to drive A:.
2. Drive B: and C: ROM capsule
3. Drive D:, E:, F: and G: Floppy disk
4. Drive I: Extension unit ROM capsule

See Chapter 14, "MTOS and MIOS" for MCT files in drive H:.

(1) Internal RAM disk

The internal RAM disk format in main memory is shown below.



(SIZRAM) contains the RAM disk size in 1K byte units. (Overseas version = 0F009H, Japanese-language version = 0ED09H)

(TOPRAM) - 1
↓
Contains the RAM disk top address (Overseas version = 0F076H, Japanese-language version = 0ED82H)

The internal RAM disk area is divided into sectors from address (TOPRAM)-1 to higher address. The sectors are numbered in ascending order as shown in the figure at left.

The structure of the directory is the same as that of the standard CP/M. Up to 16 entries can be accomodated in the directory.

The check sum area stores 1-byte check sums calculated with data in each sector.

The 9th and following sectors are used as the file area. The size of the file area is determined according to the size of the RAM disk area.

Files are managed in 1K-byte units using the allocation map in the directory.

The actual size of the file area is (SIZERAM)-1K bytes (directory area + check sum area).

(2) ROM capsule

(2-1) Types of ROM

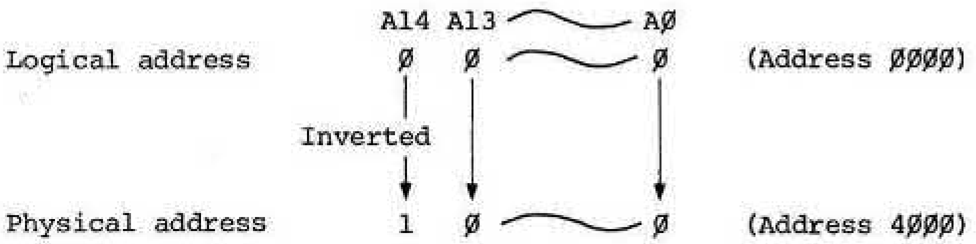
2764, 27128, and 27256 can be used as MAPLE ROM devices.

(2-2) Addresses

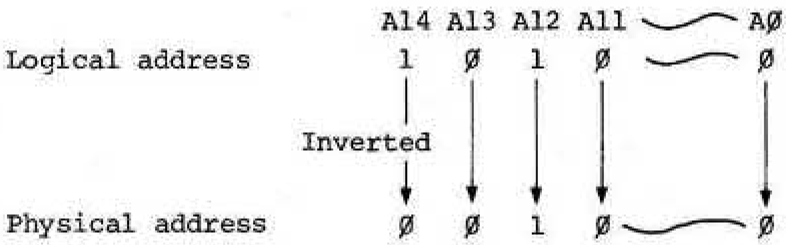
Addresses as viewed from the OS (logical addresses) have a one-to-one correspondence with actual ROM addresses (physical addresses) on 2764 and 27128. On 27256, the relationship between the logical and physical addresses is reversed at address 4000H. This is because the meaning of pin A14 is different for 2564, 27128 and 27256. On 2764 and 27128, this pin must always be set high and, therefore, the signal at pin A14 is inverted by hardware. On 27256, however, pin A14 is used for addressing. This means that address 0 is mapped into address 4000H because accessing address 0 sets A14 pin high.

Example:

◦ When accessing address ØØØØ:



◦ When accessing address 5ØØØH



Physical address viewed from the OS	Actual ROM address		
	2764	27128	27256
Ø Ø Ø Ø H	Ø Ø Ø Ø H	Ø Ø Ø Ø H	4 Ø Ø Ø H
~	~	~	~
1 F F F H	1 F F F H		
2 Ø Ø Ø H	X		
~			
3 F F F H		3 F F F H	7 F F F H
4 Ø Ø Ø H		X	Ø Ø Ø Ø H
~			~
7 F F F H			3 F F F H

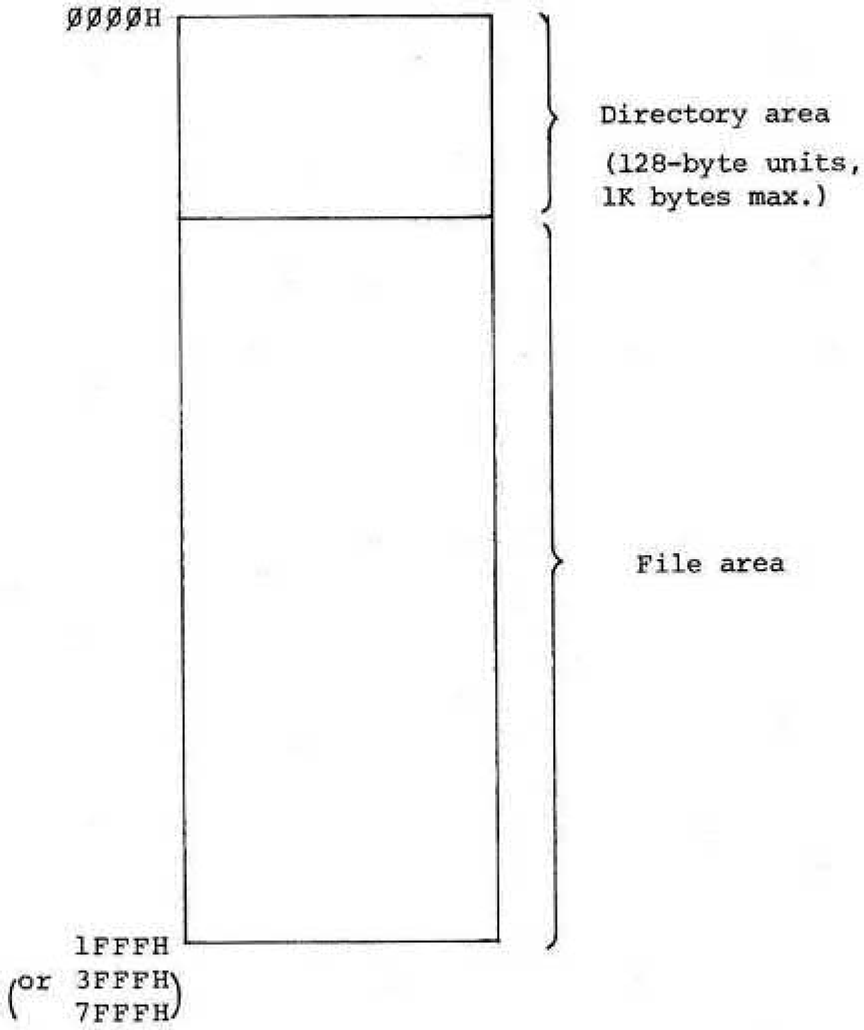
(2-3) ROM capsule memory map

The addresses referred to in the following description are all logical ones. Care must be taken when using 27256 ROM devices.

(For example, address 1000H corresponds to address 5000H in 27256 ROM.)

i) General

ROM is divided into directory and file areas.

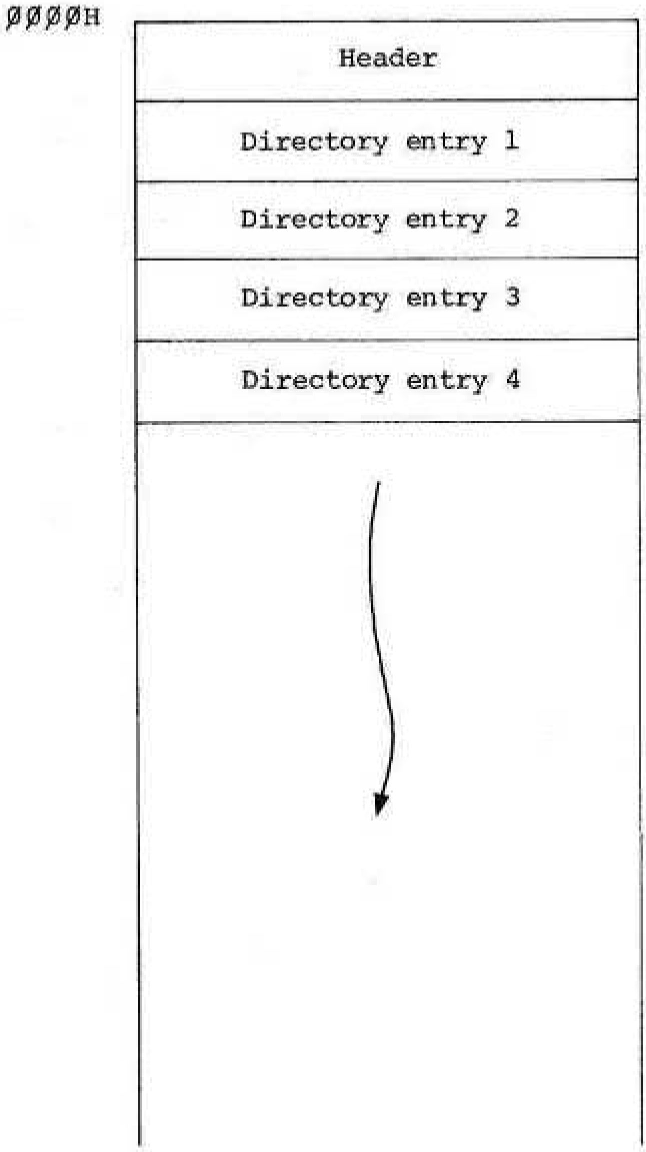


ii) Directory area

1) The directory area is divided into two sections: a header (first 32 bytes) and a directory entry area.

2) Each directory entry is 32 bytes wide and the directory can hold a maximum of 31 directory entries.

3) The directory area is allocated in 128-byte increments up to 1K bytes.



iii) Header format

	Ø	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
ØØØØH	E5H	37H	Capa-city	Check sum L	H	System name			ROM name							
ØØ1ØH	ROM name						Number of entries	"V"	Version No.		Date M	M	D	D	Y	Y

No.	Address	Description
1	0000H - 0001H	Is the ROM identifier. Always set to 0E5H and 37H.
2	0002H - 0002H	Contains the ROM capacity in 1K bytes in binary form. 2764 --- 08H 27128 -- 10H 27256 -- 20H
3	0003H - 0004H	Contains the lowest two bytes of the size of the ROM file area from the beginning of the file area to the end of ROM. 0003H contains the low-order byte and 0004H contains the high-order byte.
4	0005H - 0007H	Contains the user-specified system name.
5	0008H - 0015H	Contains a user-specified ROM name.

No.	Address	Description
6	0016H - 0016H	Contains the number of 32-byte directory entries. The number is either 04H, 08H, 0CH, 14H, 18H, 1CH, or 20H since the directory area is allocated in 128-byte units up to 1K bytes.
7	0017H - 0017H	Set to "V".
8	0018H - 0019H	Contains the ROM version number.
9	001AH - 001FH	Contains the date on which ROM is implemented (latest version).

Fields 1, 2, and 6 must be supplied by the user. The other fields are supplied by the system. (The third field (CHECK SUM) should be filled with correct data though the OS makes no check on that field.)

iv) Directory entry format

The format of the directory entries in memory is the same as that of the directory entries on the disk.

1	2 File name	3 File type	4	5 ØØH	6 ØØH	7
8 Disk allocation map						

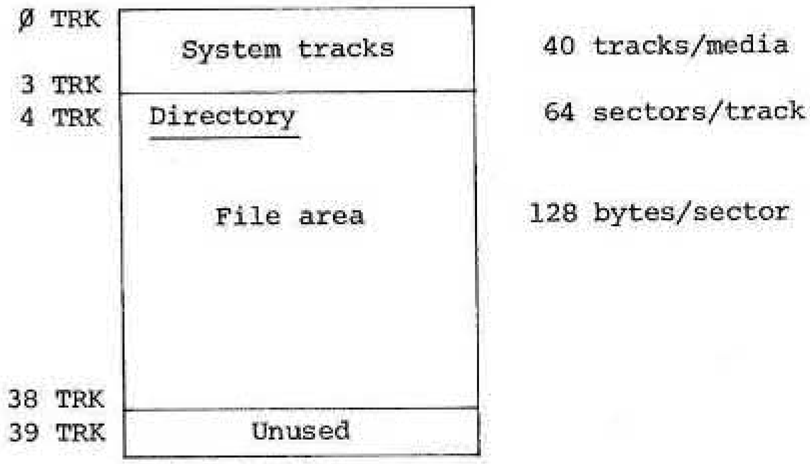
No.	Address	Size (Byte)	Description
1	0H - 0H	1	Contains 00H for a valid directory entry and 0E5H for an invalid directory entry. Invalid entries refer to free entries in a 128-byte unit directory area. In the example below, the 128-byte directory contains five valid entries and two invalid entries (64 bytes). Header Directory entry 1 Directory entry 2 Directory entry 3 (Header – Directory entry 3: 128 bytes) Directory entry 4 Directory entry 5 Invalid directory entry Invalid directory entry (Directory entry 4 – Invalid directory entry: 128 bytes)

No.	Address	Size (Byte)	Description
2	1H - 8H	8	Contains a 1- to 8-character name.
3	9H - BH	3	Contains a 1- to 3-character file type.
4	0CH - 0CH	1	The logical extent number of the current directory entry (00H - 1FH). As described later, one directory entry can manage a file extent of up to 16K bytes. Therefore, two or more directory entries are required for a file larger than 16K bytes. The logical extent number identifies a 16K-byte extent. It starts at 00H.
5	0DH - 0DH	1	Set to 00H.
6	0EH - 0EH	1	Set to 00H.
7	0FH - 0FH	1	Number of records controlled by the directory entry. (0 - 128, in binary). A record is a unit of data accessed by CP/M at a time

No.	Address	Size (Byte)	Description
			and 128 byte long. Since one directory entry can manage up to 16K bytes of data, it can manage a maximum of 128 records.
8	10H - 1FH	16	Disk allocation map. A file is actually controlled in 1K-byte block units in the file area. The block number of the block currently used by the file is indicated here. (Block numbers begin at 1 and are assigned to 1K-byte blocks sequentially from the first block. The file top location differs depending on the directory area size. The file top is indicated in the header.

(3) FD

The structure of the floppy disk is shown below:



Tracks Ø through 4 contain the boot program for the TF-2Ø floppy disk drive. Sectors 1 through 16 on track 4 are reserved for the directory. The directory can contain up to 64 entries.

The file area starts at sector 17 on track 4 and ends at sector 64 on track 38.

Track 39 is not used so that the MAPLE is compatible with the QC-1Ø/QX-1Ø which does not use track 39. The actual file area size can be calculated as follows:

1 track = 8K bytes

File area = ((40 - 4 - 1) x 8) - 2 = 278K bytes

- 40: Total number of tracks
- 4: System tracks
- 1: Unused track
- 8: Track size
- 2: Directory size

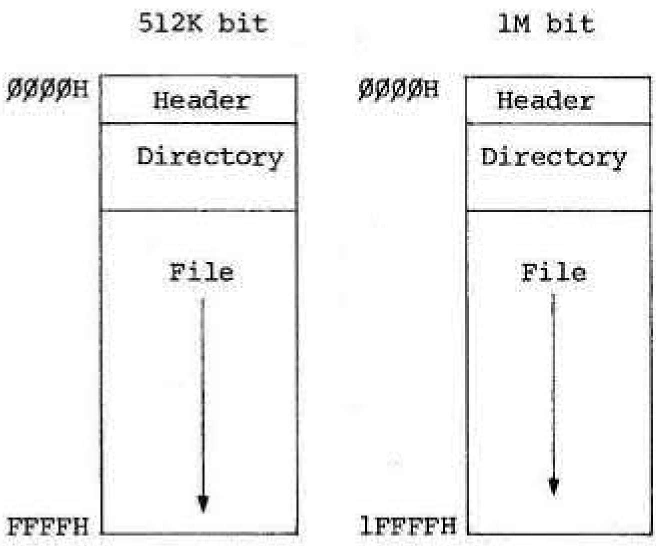
(4) Extension unit ROM capsule

Overseas MULTI UNIT 64 and MULTI UNIT II can install a ROM capsule of up to 1M bit (128K bytes). Overseas OS version B and up support a ROM capsule as drive I:.

Applicable ROM types are as follows:

i) 64K bits (8K bytes)
ii) 128K bits (16K bytes)
iii) 256K bits (32K bytes)
iv) 512K bits (64K bytes)
v) 1M bits (128K bytes)

The the format of the extension unit ROM capsule made up of 64K- to 256K-bit ROM devices is identical to that of the ROM capsule described in (2). The format of the 512K- and 1M-bit ROM capsules is also the same except that provide larger address space.



The capacity field at the second byte of the header contains different values for different ROM types.

512K-bit ROM = 40H (64K bytes)

1M-bit ROM = 80H (128K bytes)

15.3 EPSP Protocol

The MAPLE can connect to external disks of the type listed below via a serial interface. Up to two external units (four drives maximum) can be connected in daisy cain configuration.

TF-20 (5.25 inches, 2 drives)
TF-15 (5.25 inches, 1 or 2 drives)
PF-10 (3.5 inches, 1 drive)

CP/M can access these disks as drive D:, E:, F:, and G:. The physical characteristics of the serial interface to external disks are identical to those of the RS-232C interface as shown below.

Level: ±8V
Baud rate: 38,400 bps
Data length: 8 bits/word
Start bit: 1
Stop bit: 1
Parity: None.

Logically, CP/M accesses external disks by communicating with the external disks using the EPSON Serial Communication Protocol (EPSP). There are six OS commands which are used to access external disks (described on the following pages).

Application programs can access external disks directly by calling the slave BIOS call (WBOOT + 72H) with necessary parameters specified.

4) Commands for drives are summarized below.

FMT	DID	STD	FNC	SIZ	Text data No.	Function and text contents
						Reset terminal floppy.
ØØ	SS	MM	ØD	ØØ	ØØ	XX
Ø1	MM	SS	ØD	ØØ	ØØ	Return code ØØ
						Format disk.
ØØ	SS	MM	7C	ØØ	ØØ	Drive code (1 or 2)
Ø1	MM	SS	7C	Ø2	ØØ	High-order byte of the track number of the currently formatting track
					Ø1	Low-order byte of the track number of the currently formatting track [Ø - 39 / FFFF: end]
					Ø2	Return code (BDOS error or Ø)
						Read disk direct.
ØØ	SS	MM	77	Ø2	ØØ	Drive code (1 or 2)
					Ø1	Track No. (Ø - 39)
					Ø2	Sector No. (1 - 64)
Ø1	MM	SS	77	8Ø	ØØ ~ 7F	Read in data (128 bytes)
					8Ø	Return code (BDOS error or Ø)
						Write disk direct.
ØØ	SS	MM	78	83	ØØ	Drive code (1 or 2)
					Ø1	Track No. (Ø - 39)
					Ø2	Sector No. (1 - 64)
					Ø3	Contents of C reg. (write type) (Ø - 2)*1
					Ø4 ~ 83	Write data (128 bytes)
Ø1	MM	SS	78	ØØ	ØØ	Return code (BDOS error or Ø)

FMT	DID	STD	FNC	SIZ	Text data No.	Function and text contents
						Flush buffer.
ØØ	SS	MM	79	ØØ	ØØ	XX
Ø1	MM	SS	79	ØØ	ØØ	Return code (BDOS error or Ø)

						Disk volume.
ØØ	SS	MM	7A	ØØ	ØØ	Drive code (1 or 2)
Ø1	MM	SS	7A	Ø2	ØØ	High-order byte of the track number of the currently copying track
					Ø1	Low-order byte of the track number of the currently copying track [Ø - 39 FFFF: end]
					Ø2	Return code (BDOS error or Ø)

The command 7AH (Copy All disk) is used not by the OS but used by the disk utility program COPYDISK. The function is not supported for one-drive disk systems (PF-1C, for example).

Command Descriptions

FMT: Identifies the header block type.

ØØH: Indicates message transmission from the main unit (MAPLE).

ØlH: Indicates message transmission from the FDD.

(All values in FMT through SIZ is in hexadecimal.)

DID: Destination device ID. This identifies the drive to which the current message (command) is to be sent when two FDDs are connected in daisy chain configuration.

31H: First drive (Drive D: or E:)

32H: Second drive (Drive F: or G:)

The device of address of the FDDs (TF-2Ø, for example) is determined by DIP switches.

SID: Source device ID

Identifying the source of the current message (command). This field contains 22H if the message (command) is from the MAPLE.

FNC: Command for FDD.

SIZ: Indicates the text block length (ØØH - ØFFH). The value in this field is the length of the actual text block minus 1.

Text block: A block of data necessary for executing the command. This block can contain 1 to 256 data bytes.

1) Reset Terminal Floppy (RESET)

Causes the FDD to initialize itself and wait for an ENQ block. The FDD returns return code 00 to the system.

2) Format Disk (FORMAT)

Causes the FDD to format two tracks and return the corresponding track number (logical numbers) and a return code to the system. The FDD continues formatting in two track units and sets the logical track number in the return message to 0FFFFH when it completes formatting.

3) Read Disk Direct (READ)

Causes the FDD to transfer the data (128 bytes) to the system from the disk sector on the specified logical track at the specified sector number and a return code to the system. Deblocking technique (physical to logical conversion of tracks and sectors) is adopted to speed up this processing.

4) Write Disk Direct (WRITE)

Causes the FDD to write the specified data (128 bytes) to the location on the disk addressed by the specified logical track and sector numbers. Actually, this command only places the specified data into the 1K-byte host buffer because of the blocking technique (logical to physical conversion of tracks and sectors).

5) Flush Buffer (WRITEHST)

Causes the FDD to flush the contents of the 1K-byte buffer filled by the WRITE command onto the disk.

6) Copy Volume

Causes the FDD to copy the entire diskette on the specified drive onto another diskette. This command is not available if the system has only one drive.

7) Return codes

Return code (hex)	Meaning	
00	Normal termination	
FA	BDOS error	Read error
FB		Write error
FC		Drive select error
FD		Write protect
FE		

*1: The third byte of the data block for FNC=78H indicates the write mode:

ØØH: Standard write (The FDD blocks data before write.)

Ø1H: Flush buffer (The FDD immediately writes data on the FD without blocking.)

Ø2H: Sequential write

ØØH is used when writing ordinary files. Ø1H is used only when writing directories.

Other commands

The FDD supports some other commands in addition to the six commands used by the MAPLE. Refer to FDD manuals for further information on these commands. They can also be activated easily by calling the slave BIOS function (WBOOT + 72H).

15.4 DIP Switches

The table below lists the uses of the DIP switches on the main unit back panel.

Uses of DIP switches

<table>
<tr><th>SW</th><th>Overseas version</th><th>Kana and Japanese-language version</th></tr>
<tr><td>1</td><td rowspan="4">Identifies the keyboard type.</td><td>Identifies the keyboard type.
Ø = Kana keyboard
1 = Japanese-language keyboard or touch type keyboard</td></tr>
<tr><td>2</td><td>Not used.</td></tr>
<tr><td>3</td><td>Not used.</td></tr>
<tr><td>4</td><td>Not used.</td></tr>
<tr><td>5</td><td>Specifies whether the check sum is to make a check at power-on time when the RAM disk unit 6Ø or 12Ø is connected.'
Ø = No check made
1 = Check made</td><td>⟸</td></tr>
<tr><td>6</td><td>Specifies the range of code conversion to be used during screen dump.
Ø = Converts ØØH - 1FH, 7FH, or ØFFH to a space.
1 = Converts ØØH - 1FH or 7FH - ØFFH to a space.</td><td>Not used.</td></tr>
<tr><td>7</td><td>Not used.</td><td>Not used.</td></tr>
<tr><td>8</td><td>Not used.</td><td>Not used.</td></tr>
</table>

Chapter 19 Application Notes

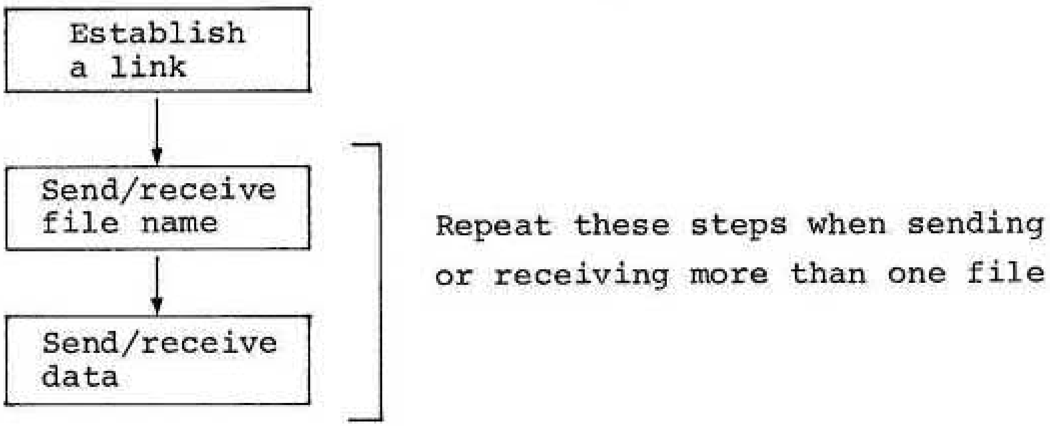
This chapter gives various information which will aid the user in developing application programs.

Interface

19.12 Procedure for Sending and Detecting the RS-232C Break Signal

19.1 FILINK Communications Protocol

FILINK transmits and receives files via the RS-232C interface using the protocol illustrated below.



The above communications protocol is supported by the programs/commands listed below.

Machine Type	Program/Command
MAPLE	◦ FILINK.COM ◦ WS.COM T and C commands ◦ SC.COM/JSC.COM/Join, Send, and Receive commands
PINE (HC-40, PX-4, HX-40)	◦ FILINK.COM
QC - 10 QX - 10	◦ FILINK.COM
IBM-PC	◦ FILINK.COM (EXE)

The FILINK communications protocol is detailed below.

Establish a Link

Sender		Receiver
(1)-Send "R".	→	-Send "S" if "R" is received. -Send received data if data other than "R" is received
↑ (≠"S")	↙ (="S")	
(2)-Send "G" if "S" is received. Proceed to "Send File Name." -Go to (1) if other than "S" is received.	→	-Proceed to "receive File Name" if "G" is received. -Wait if other than "G" is received.

Send/Receive File Name

Sender	Receiver
(3)- Send 04H.	-Send 08H if 04H is received. -Terminate FILINK if 13H is received. -Otherwise, send "X" and wait (also display data).
(≠08H) ↑	↑ (≦1FH)
(4)-Go to (5) if 08H is received. -Go to (3) if other than 08H is received.	
(5)-Send file name and extension, one character at a time.	-Send received character. -If received character is 1FH or smaller, send "X" and return to step (3) for receiver.
(6)-Compare received character and send character transmitted in (5). If match→Go to (5) to send next character. If no match→Display "?" and go to (3).	

Repeat steps (5) and (6) 11 times to send/receive file name and extension.

Sender	Receiver
(7)-Send 05H.	-Send 09H and proceed to "Send/Receive Data" if 05H is received. -Send "X" and return to step (3) for receiver if other than 05H is received.
(8)-Proceed to "Send/Receive Data" if 09H is received. -Go to (3) if other than 09H is received.	

Send/Receive Data

Sender	Receiver
(9) -Read 1 record (128 bytes). -If not EOF, send 02H. -If EOF, send 03H. If all files have been sent, send 13H to terminate FILINK. Return to (3) if there is a file to be sent.	-Send "P" and go to (11) if 02H is received. -Go to step (3) for receiver if 03H is received. -Otherwise, send "N" and wait.
(10) -Go to (11) if "P" is received. -Otherwise, go to (9).	
(11) -Send 1 record (128 bytes) and check byte.	-Receive 1 record (128 bytes) and check byte.
(12)	-Compare check bytes. If match→Send "G", writes received record into a file, and return to (9). -If no match→Send "B" and return to (9).
(13) -Read next record and return to (9) if "G" is received. -Return to (9) for a retry if "B" is received. -Otherwise, wait here.	

19.2 Procedure for Calling BDOS and BIOS Directly from BASIC

To call a BDOS or BIOS function directly from BASIC, prepare a machine-language program for interfacing to BDOS or BIOS and run it using the BASIC CALL statement.

19.2.1 Calling BDOS

(Machine-language program)

C5, 4E, E3, 5E, 23, 56, CD, Ø5,
ØØ, C1, Ø2, Ø3, AF, Ø2, C9 (15 bytes)

```
PUSH  BC
LD    C,(HL)
EX    DE,HL
LD    E,(HL)
INC   HL
LD    D,(HL)
CALL  5
POP   BC
LD    (BC),A
INC   BC
XOR   A
LD    (BC),A
RET
```

(BASIC)

```
CALL BDOS(C%, DE%, A%)
```

BDOS specifies the address of the machine-language routine.

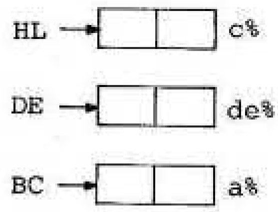
C% specifies the BDOS function number (C% = 255 for dirinit).

DE% specifies the RCB address (optional).

A% holds the return code returned by BDOS (Ø = normal termination; nonzero = error).

(Example)

```
100 CLEAR ,&HA000: BDOS=&HA000
110 FOR I=0 TO 14: READ X: POKE BDOS+I,X
: NEXT
120 C%=255: CALL BDOS(C%,DE%,A%)
130 IF A%<>0 THEN PRINT"Error"
140 DATA &Hc5,&H4e,&Heb,&H5e,&H23,&H56,&
Hcd,&H05
150 DATA &H00,&Hc1,&H02,&H03,&Haf,&H02,&
Hc9
```



19.2.2 Calling BIOS

Change Ø5H, ØØH (BDOS entry address) of the byte sequence CDH, Ø5H, ØØH in the above machine-language program to the required BIOS entry address. To locate the BIOS entry address, read the WBOOT entry address stored in RAM addresses 1 and 2 with the PEEK statement and add to it the offset value of the required BIOS function (see Chapter 4 for details about the procedure for calculating a BIOS entry address).

19.3 Procedure for Determining the Type and Size of RAM Disk

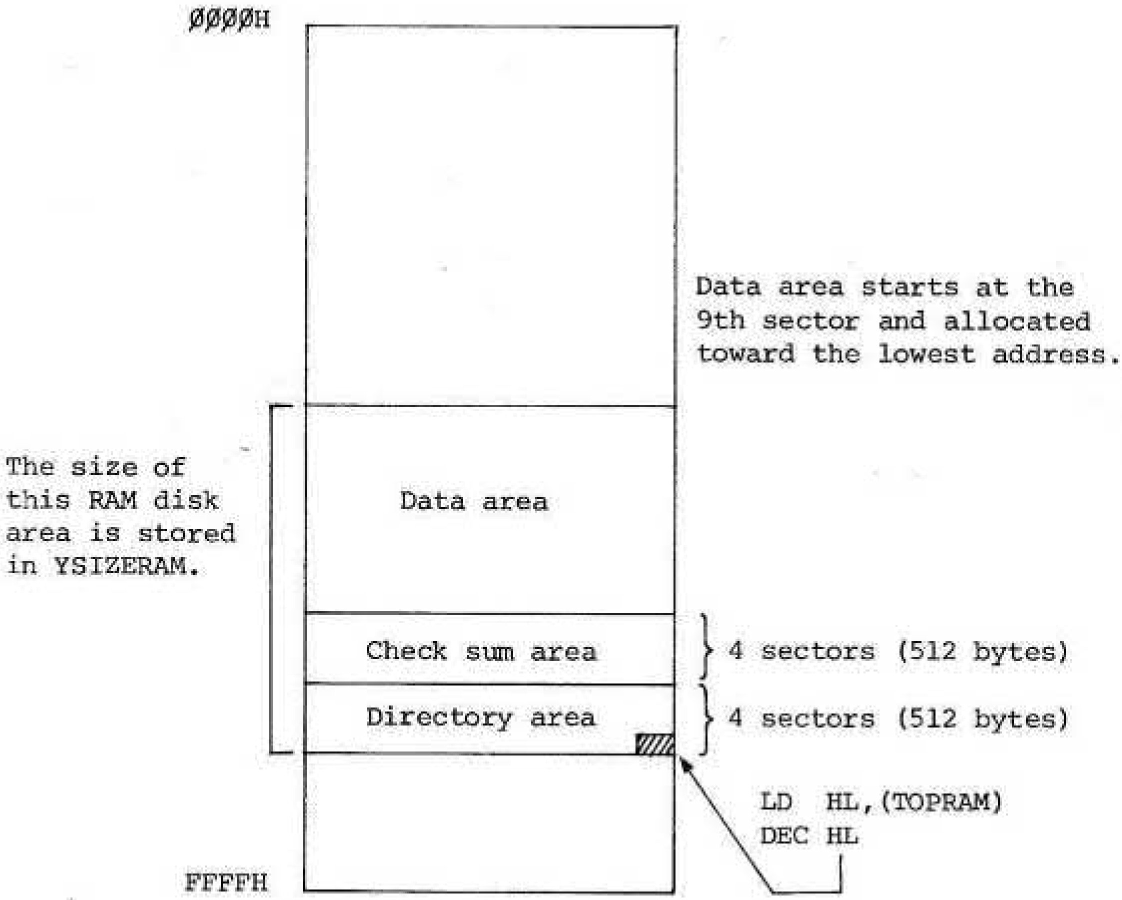
The MAPLE has the following three types of RAM disks:

- Main memory RAM disk
- Intelligent type RAM disk (in expansion unit)
- Unintelligent RAM disk (in expansion unit)

RAM work area YSIZERAM (at location 0F6A8H for overseas version and 0F42BH for Japanese-language version) contains the size in binary form of the active RAM disk in 1K-byte increments. The value of this area also indicates the type of RAM disk.

YSIZERAM contents	RAM disk type
60	60K-byte intelligent RAM disk unit
120	120K-byte intelligent RAM disk unit
64	64K-byte unintelligent RAM disk unit
128	128K-byte unintelligent RAM disk unit
Other value	Indicates the size of the main memory RAM disk.

See Chapter 16 for the formats of the intelligent and unintelligent RAM disk units. The rest of this section describes the format of the main memory RAM disk.



The lowest address of the RAM disk (marked ///) is calculated as the value of the 2-byte field labeled TOP RAM minus 1. The location of TOPRAM is 0F076H for overseas versions and ØED82H for Japanese-language version.

19.4 CG Fonts

The fonts used for the MAPLE are contained in SED1320 on the LCD controller (except those for Japanese-language kanji, hiragana, and katakana characters). During an OS operation, a character code issued through the BIOS CONOUT routine is converted into the corresponding code in the CG. The converted code is sent to the SED1320 via the slave CPU and used to select the corresponding font, which is then displayed on the LCD screen. A table of CG fonts are given on the next page.

The fonts for the gaiji characters corresponding to character codes 0E0H through 0FFH are stored in the slave CPU. These character codes are converted into fonts within the slave CPU and sent to the SED1320 for display.

The application program can display these CG fonts directly by sending the ESC, "%", (CG code) sequence with the CONOUT BIOS function (see Chapter 6).

To get a CG font pattern from an application program, use the slave CPU command code 1BH (see Chapter 13).

CG ROM Fonts

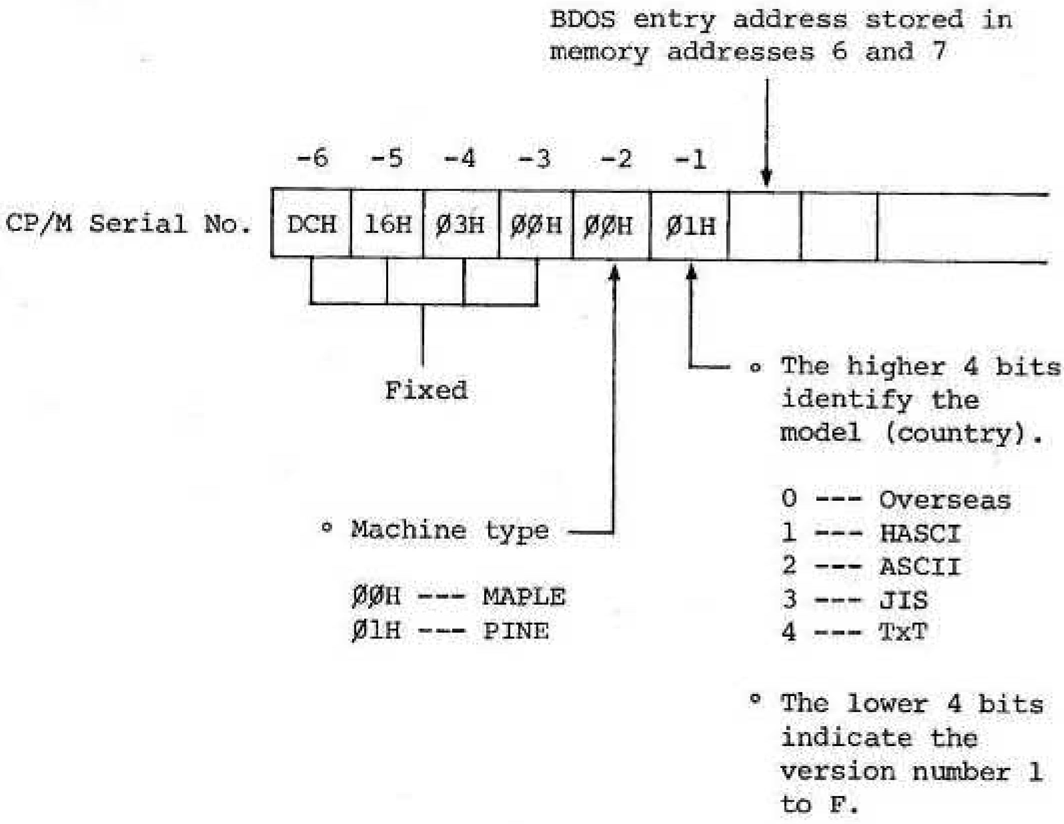
High order byte (columns) / Low order byte (rows)

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	à	Æ	SP	0	@	P	`	p	┼	○	SP	ー	タ	ミ		
1	°	ø	!	1	A	Q	a	q	┴	♠	。	ア	チ	ム		
2	ç	Å	"	2	B	R	b	r	┬	♥	「	イ	ツ	メ		
3	ş	æ	#	3	C	S	c	s	┤	♦	」	ウ	テ	モ		
4	é	¢	$	4	D	T	d	t	├	♣	、	エ	ト	ヤ		
5	ù	ä	%	5	E	U	e	u	─	♪	・	オ	ナ	ユ		
6	è	É	&	6	F	V	f	v	│	☎	ヲ	カ	ニ	ヨ		
7	¨	å	'	7	G	W	g	w	┌	♣	ァ	キ	ヌ	ラ		
8	Ä	¤	(	8	H	X	h	x	┐	♠	ィ	ク	ネ	リ		
9	ö	ò	)	9	I	Y	i	y	└	♀	ゥ	ケ	ノ	ル		
A	Ü	ì	*	:	J	Z	j	z	┘	大	ェ	コ	ハ	レ		
B	ã	₧	+	;	K	[	k	{	▒	↑	ォ	サ	ヒ	ロ		
C	ö	¡	,	<	L	¥	l	¦	█	↓	ャ	シ	フ	ワ		
D	ü	Ñ	-	=	M	]	m	}	▬	×	ュ	ス	ヘ	ン		
E	ß	¿	.	>	N	^	n	~	▌	÷	ョ	セ	ホ	゛		
F	£	ñ	/	?	O	_	o	△	●	±	ッ	ソ	マ	゜		

19.5 Procedure for Identifying the OS Version from an Application Program

MAPLE/PINE (HC-40, PX-4, HX-40) application programs can prevent themselves from causing fatal errors or hanging up when executed under an unintended operating system by checking the version of the running operating system at the beginning of their execution.

To check the OS version, refer to the 6-byte CP/M serial number filed in BDOS that contains the machine type, model (country) name, and version number.



How to refer to the CP/M serial number field

(1) Application programs not dedicated to the MAPLE/PINE need not check the version number. Programs that fall within this category include:

- Programs that reference no system area.
- Programs whose screen handling routines are not intended for MAPLE/PINE.
- Other programs

(2) Since the MAPLE has different memory maps for its overseas and domestic versions, application programs for the MAPLE are also divided into two groups. These programs must use different procedures for identifying the OS version.

1) Application programs for overseas versions

DCH, 16H, Ø3H, ØØH, ØØH, ØXH (X = 1-F)
DCH, 16H, Ø3H, ØØH, ØØH, 1XH (X = 1-F)
DCH, 16H, Ø3H, ØØH, ØØH, 2XH (X = 1-F)

The application programs can run under operating systems that contain one of the OS version field values given above. They should signal an error condition for other values.

2) Application programs for Japanese-language version.

DCH, 16H, Ø3H, ØØH, ØØH, 3XH --> JIS OS

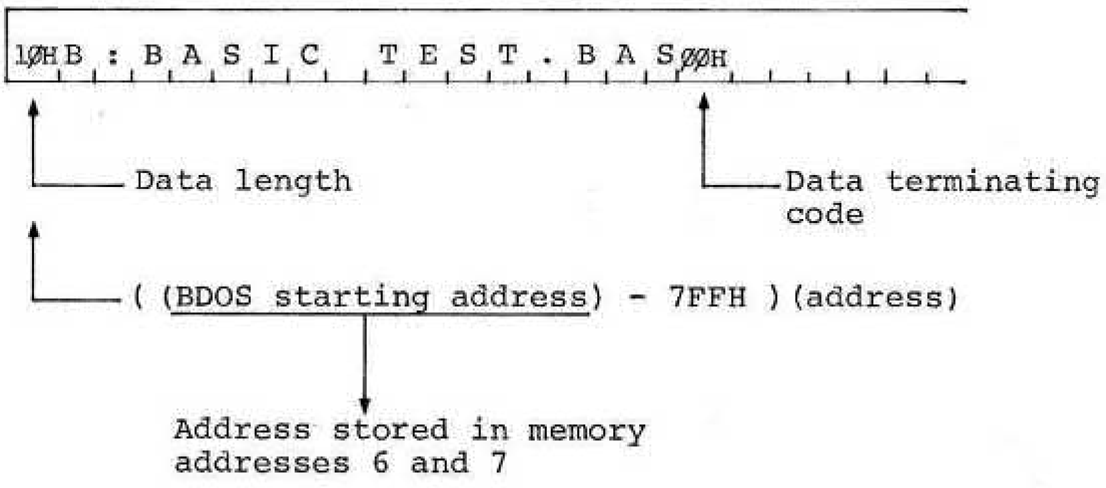
DCH, 16H, Ø3H, ØØH, ØØH, 4XH --> TXT OS (X = 1-F)

The application programs can run under operating systems that contain one of the OS version field values given above. They should signal an error condition for other values.

19.6 Procedure for Checking the Data Received by CCP from an Application Program

When CCP starts an application program, it loads the command line parameters in CP/M system areas at Ø5CH and 8ØH. CCP, however, deletes the name of the application program and the drive number of the disk drive from which the application program is started. Consequently, the application program cannot determine from which drive it was loaded into memory. The application program can, however, refer to the parameter data that the user specified via CCP by examining the CCP work area.

Example: A>B:BASIC TEST.BAS/



19.7 Procedure for Detecting the Depression of the CTRL/STOP keys

When the STOP key is pressed, the OS usually clears the keyboard buffer and places a 03H (STOP key code) in the keyboard buffer. When the STOP key is pressed simultaneously with the CTRL key, however, the OS terminates the currently executing I/O operation as well as it clears the keyboard buffer and places a 03H code in the keyboard buffer. This allows the user to gain control when the program is placed in a loop waiting, for example, for receive data in the RS-232C receive routine. In this case, however, the application program must know that the CTRL and STOP keys have been pressed to terminate itself. This can be accomplished by examining the flag field described below.

CSTOPFLG (0F10BH for overseas version; 0EE25H for Japanese-language version)

- = 00H: The CTRL and STOP keys are not pressed.
- ≠ 00H: The CTRL and STOP keys have been pressed.

After the CTRL and STOP keys are pressed simultaneously, the keyboard buffer contains only 03H code and CSTOFLG is set to a nonzero value. CSTOPFLG is cleared by the OS when the keyboard buffer is emptied.

19.8 Procedure for Assigning Printer Output to RS-232C or Serial Interface

Output to the printer can be directed to either RS-232C or serial port by changing the contents of the I/O byte (at memory address 3).

I/O byte, bits 7 and 6 ... 1, Ø --> RS-232C

I/O byte, bits 7 and 6 ... Ø, Ø --> Serial

Output data will be placed on the specified port when the following list-related commands or routines are executed after the I/O byte is altered as shown above:

(1) BIOS level

LIST routine (WBOOT + ØCH)

(2) BDOS level

Function 5 (list)

(3) BASIC level

LPRINT command

19.9 Procedure for Restoring the Screen into the State Set up by CONFIG

The screen remains in the state set up by an application program when WBOOT is performed at the end of the application program whereas the screen is restored into the state that is defined by CONFIG when BOOT is invoked by pressing the RESET switch. Any application program which reconfigures the screen should restore the screen into the original configuration at the end of its execution.

The OS stores in RAM memory the ESC sequence data related to the screen state defined by CONFIG. The application program can restore the screen configuration into the original state by sending this data to the screen using CONOUT.

The ESC sequence data is stored in the two areas given below. The ESC sequence data in each area is terminated by ØFFH code, so the application program need only send the data bytes until an ØFFH is encountered.

CONSCRN1 (ØFØDDH for overseas version; ØEDBDH for

Japanese-language version): Contains the current screen mode and virtual screen identification.

CONSCRN2 (ØFØF1H for overseas version; ØEDD1H for Japanese-language version): Contains data related to the cursor.

[Sample program]

```
        DI
        LD    HL,CONSCRN1     ;screen mode, select screen
        CALL  LCDOUT          ;scroll mode, function key display
        LD    HL,conscrn2     ;cursor kind and on/off
        CALL  LCDOUT
        EI
        .
        .
LCDOUT:
        LD    A,(HL)
        INC   HL
        INC   A               ;end of string?
        RET   Z               ;then return
        DEC   A
        LD    C,A
        PUSH  HL
        CALL  CONOUT          ;display character
        POP   HL
        JR    LCDOUT
```

19.10 Procedure for Configuring the System Environment from an Application Program

19.10.1 Auto Power Off (common to both overseas and Japanese-language versions)

See 7.6 "Auto Power Off Feature."

19.10.2 CP/M Function Key (common to both overseas and Japanese-language versions)

See paragraph (6) "Programmable Function keys" in 5.6 "Special Keys."

19.10.3 Cursor & Function Key Display (common to both overseas and Japanese-language versions)

(1) Use the CONOUT ESC sequence function to set up the cursor and function key display modes.

- Cursor tracking:	ESC, 95H
- Cursor display:	ESC, "2" or ESC, "3"
- Cursor type:	ESC, D6H
- Function key display:	ESC, D3H

(2) The current settings can be located by checking the following work areas:

- Cursor tracking:

  LSMODE (ØF2D4H for overseas version; ØF004H for Japanese-language version)

  = ØØH: Tracking mode

  ≠ ØØH: Nontracking mode

- Cursor display:

  LUSSTS (ØF2D7H for overseas version; ØFØØ7H for Japanese-language version)

  Bit Ø = Ø: Off

  Bit Ø = 1: On

- Cursor type:

  LUSSTS (ØF2D7H for overseas version; ØFØØ7H for Japanese-language version)

  Bit 1 = Ø: Nonblink

  Bit 1 = 1: Blink

  Bit 2 = Ø: Underline

  Bit 2 = 1: Block

- Function key display

  LUFKDSP (ØF2DØH for overseas version; ØFØØ2H for Japanese-language version)

  = 7: Display

  = 8: No display

The screen may not actually change its configuration when the above work areas are simply changed. This is attributed to reasons associated with the interactions between the screen and other resources. Nevertheless, the screen configuration must be set up using the CONOUT ESC sequence functions.

19.10.4 Date and Time (common to both overseas and Japanese-language versions)

Use the TIMDAT BIOS function (WBOOT + 4BH) (see Chapter 4).

19.10.5 Disk Drives (common to both overseas and Japanese-language versions)

Refer to or change the table in RAM associating the physical and logical drives.

Physical drive codes

00H:	RAM disk
01H:	ROM capsule 1
02H:	ROM capsule 2
03H:	FDD1
04H:	FDD2
05H:	FDD3
06H:	FDD4

The logical drives are indicated in the table shown below.

Offset	Contents
DISKTBL	Drive A (defaults to 00H)
+1	Drive B (defaults to 01H)
+2	Drive C (defaults to 02H)
+3	Drive D (defaults to 03H)
+4	Drive E (defaults to 04H)
+5	Drive F (defaults to 05H)
+6	Drive G (defaults to 06H)

DISKTBL: (0F1D2H for overseas version; 0EEEBH for Japanese-language version)

Change the contents of the DISKTBL to redefine the association between the physical and logical drives (e.g., reassigning an FDD to drive A).

Notes:

1. Do not specify values other than ØØH through Ø6H as physical drive codes.
2. Do not specify a physical drive code in duplicate.
3. Specify logical drives between A: and G:
4. The redefined specifications remain valid until the RESET switch is pressed.

19.10.6 Printer (common to both overseas and Japanese-language versions)

Use the I/O byte (see 19.8).

19.10.7 RS-232C (RS-232C (1) for Japanese-language version)

The 5-byte field starting at RDSDAT (0F00FH for overseas version and 0ED0FH for Japanese-language version) contains the parameter values from bit rate through special parameter that are set up by the BIOS RSIOX OPEN function. See Chapter 4.

All conditions pertaining to the RS-232C interface (for BIOS RSOPEN, RSOUT, LIST, PUNCH, etc.) are controlled by the data in this field except when using the RS-232C interface after opening it with the RSIOX OPEN function.

19.10.8 Screen mode (common to both overseas and Japanese-language versions)

(1) Send the ESC 0D0H sequence using the BIOS CONOUT function (WBOOT + 9) to setup the screen mode. See Chapter 6.

(2) The current screen modes can be identified by checking the following work areas:

- Screen mode

  LSCMODE (0F2C9H for overseas version; 0EFFBH for

Japanese-language version)

= ØØH: Screen mode Ø

= Ø1H: Screen mode 1

= Ø2H: Screen mode 2

= Ø3H: Screen mode 3

- Virtual screen 1

  LV1SCT + 4 (ØF71FH for overseas version; ØF56DH for Japanese-language version): Contains the number of virtual screen 1 columns in binary form.

  LV1SCT + 5 (ØF72ØH for overseas version; ØF56EH for Japanese-language version): Contains the number of virtual screen 1 rows in binary form.

- Virtual screen 2

  LV2SCT + 4 (ØF725H for overseas version; ØF573H for Japanese-language version): Contains the number of virtual screen 2 columns in binary form.

  LV2SCT + 5 (ØF726H for overseas version; ØF574H for Japanese-language version): Contains the number of virtual screen 2 rows in binary form.

- Selected screen:

  LDSPVS (ØF2CAH for overseas version; ØEFFCH for Japanese-language version)

  = ØØH: Displays virtual screen 1.

= ØlH: Displays virtual screen 2.

- Separation character

  LBOUNDP (ØF2D9H for overseas version; ØFØØ9H for Japanese-language version): Contains the character code proper.

19.10.9 Serial (common to both overseas and Japanese-language versions)

DHSDAT (0F014H for overseas version; 0ED14H for Japanese-language version)

= 01H:	4,800 bps
= 02H:	600 bps
= 03H:	150 bps

19.10.10 Country (overseas version only)

YLDFLTC (0F6A1H for overseas version)

= 0FH:	ASCII
= 0EH:	France
= 0DH:	Germany
= 0CH:	England
= 0BH:	Denmark
= 0AH:	Sweden
= 09H:	Italy
= 08H:	Spain
= 06H:	Norway

When this work area is altered, only the display modes are changed and no keyboard mode is changed. After a

WBOOT, the character fonts of the selected country are enabled for display.

19.11 XON/XOFF Control for the Currently Open RS-232C Interface

The following work area is referenced to determine how XON/XOFF control is exercised for the currently open RS-232C interface:

SKXFLG (ØF6C4H for overseas version; ØF447H for Japanese-language version)

Bit 4 = Ø:	XON/XOFF control disabled
Bit 4 = 1:	XON/XOFF control enabled
Bit 6 = Ø:	XON has been sent.
Bit 6 = 1:	XOFF has been sent.
Bit 7 = Ø:	XON has been received.
Bit 7 = 1:	XOFF has been received.

19.12 Procedure for Sending and Detecting the RS-232C Break Signal

19.12.1 Sending the RS-232C Break Signal

Run the following program:

```
LD   A, 3FH
OUT  (ØDH), A

Call software timer to provide a delay
required for sending the code

LD   A, 37H
OUT  (ØDH), A
```

19.12.2 Detecting the RS-232C Break Signal

Use the following program:

```
IN   A, (ØDH)
```

Areg. bit 6 = Ø: No Break signal

Areg. bit 6 = 1: Break signal detected

See an 8251 manual for further information.