Radio Frequency Interference Statement

"This equipment generates and uses radio frequency energy and if not installed and used properly, that is, in strict accordance with the manufacturer's instructions, may cause interference to radio and television reception. It has been type tested and found to comply with the limits for a Class B computing device in accordance with the specifications in Subpart J of Part 15 of FCC Rules, which are designed to proved reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

..... reorient the receiving antenna
..... relocate the computer with respect to the receiver
..... move the computer away from the receiver
..... plug the computer into a different outlet so that computer and receiver are on different branch circuits.

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions.

The user may find the following booklet prepared by the Federal Communications Commission helpful: "How to Identify and Resolve Radio-TV Interference Problems."

This booklet is available from the US Government Printing Office, Washington, D.C., 20402, Stock No. 004-000-00345-4."

Note You can determine whether your computer is causing interference by turning it off. If the interference stops, it was probably caused by the computer or its peripheral devices. To further isolate the problem:

Disconnect the peripheral devices and their input/output cables one at a time. If the interference stops, it is caused by either the peripheral device or its I/O cable. These devices usually require shielded I/O cables. For Epson peripheral devices, you can obtain the proper shielded cable from your dealer. For non-Epson peripheral devices contact the manufacturer or dealer for assistance.

WARNING

This equipment has been certified to comply with the limits for a Class B computing device, pursuant to Subpart J of Part 15 of FCC Rules. Only peripherals (computer input/output devices, terminals, printers, etc.) certified to comply with the Class B limits may be attached to this computer. Operation with non-certified peripherals is likely to result in interference to radio and TV reception.

EPSON PORTABLE COMPUTER

PX-4

OPERATING MANUAL

Trademark Acknowledgments

CP/M® is a registered trademark of Digital Research, Inc.
BASIC (Copyright 1977 – 1983 by Microsoft and Epson) is upward compatible with the BASIC-80 specifications of Microsoft, Inc.
MICROCASSETTE™ is a trademark of Olympus Optical Co., Ltd.

TABLE OF CONTENTS

Contents of the Operating Manual

This Operating Manual is composed of five chapters and seven appendices. The contents of each of the chapters is as shown in the index below.

Chapter 1 GETTING ACQUAINTED
Describes the parts of PX-4, explains its functions, and introduces the hardware and software components of the system.

Chapter 2 OPERATION
Provides a detailed explanation of first-time operating procedures for PX-4 and how to use its various convenient features. Lists the CP/M commands.

Chapter 3 STANDARD INPUT/OUTPUT INTERFACES
Explains the functions of the standard I/O interfaces built into PX-4 and how to use them.

Chapter 4 OPTIONAL DEVICES
Introduces the optional devices which can be used with PX-4 and procedures for connecting and using them.

Chapter 5 UTILITY ROM
Describes procedures for using CP/M transient commands provided in the PX-4's Utility ROM.

Appendices
Provides a variety of technical information regarding PX-4's hardware and software.

This manual is intended to be read in sequence starting from Chapter 1. However, if you already have some experience with computers or want to start programming in BASIC immediately, you may start reading from Chapter 2.

Chapter 1

GETTING ACQUAINTED

1.1 Elements of the PX-4 System

1.1.1 Unpacking

Open the carton and remove the PX-4 computer and all its accessories.

1 PX-4
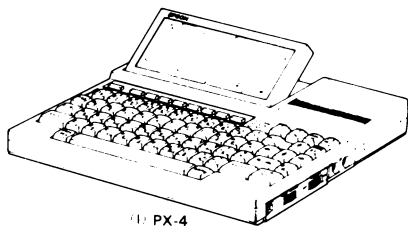
2 AC Adapter
&
Ni-Cd Battery
or
Dry Batteries
(AA-size × 4)

5 End-user License Agreement

3 Operating Manual   4 BASIC Reference Manual

6 Programmable Function Key Labels
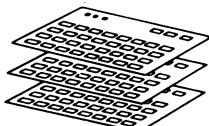
(7 Overlay Sheets)

1.1.2 Appearance

PX-4 is a high performance hand-held computer which combines a keyboard, a liquid crystal display screen, and a variety of interfaces all in one package. Its compact size and light weight makes it easy to carry and use practically anywhere.

Before starting to use the computer, take a moment to become familiar with its appearance and the names of its various parts.

(Standard keyboard)

(Item keyboard)

(Bottom panel)

(Back panel)

Interface connectors

Connector for AC power supply adapter

View angle control knob

Power switch

External speaker jack

Bar code reader interface

System bus

(Side panel)
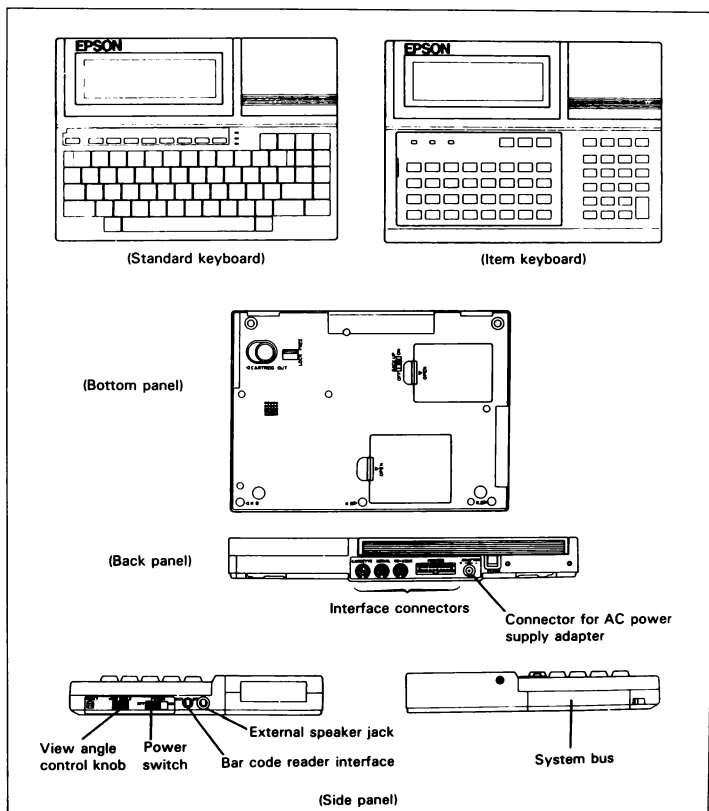
LCD Release Button

The LCD screen can be tilted forward by lifting the screen at the top while pressing this button. When returning the screen to its storage position (tilted back), push it back until the screen latch clicks into place.

(Back panel)

LCD release button

(Side panel)
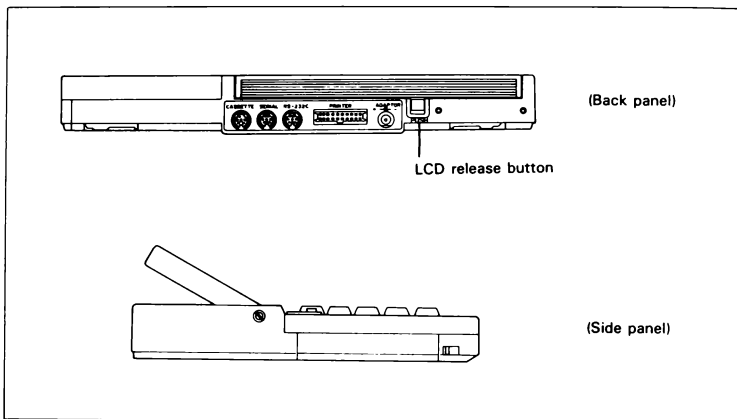
View Angle Control Knob

Turning this knob changes the apparent display contrast.

View angle control knob
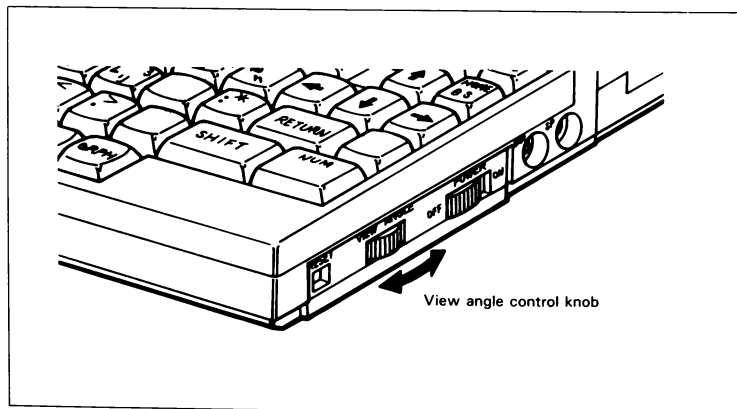
Legs

Two folding legs are built into PX-4's back panel. Extend these legs when you want increase the angle of keyboard inclination.
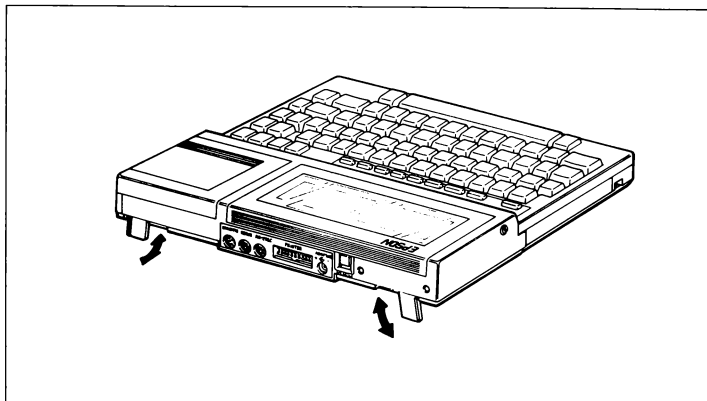
Connector for AC Power Supply Adapter
When using the AC power supply adapter, connect it to PX-4 as shown in the figure below.
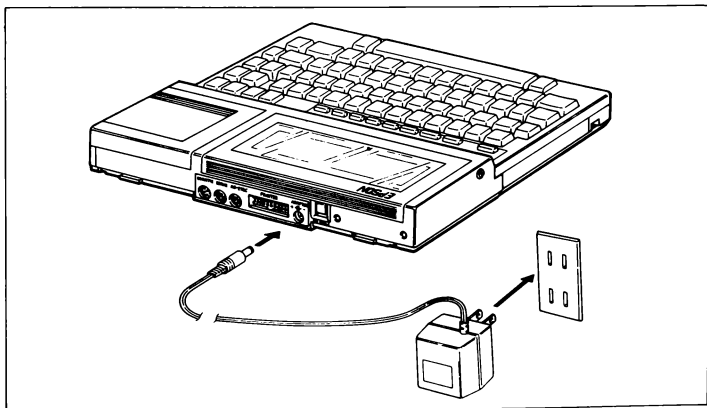
Battery Compartment

The battery compartment houses PX-4's main batteries (dry cells or NiCd battery pack).
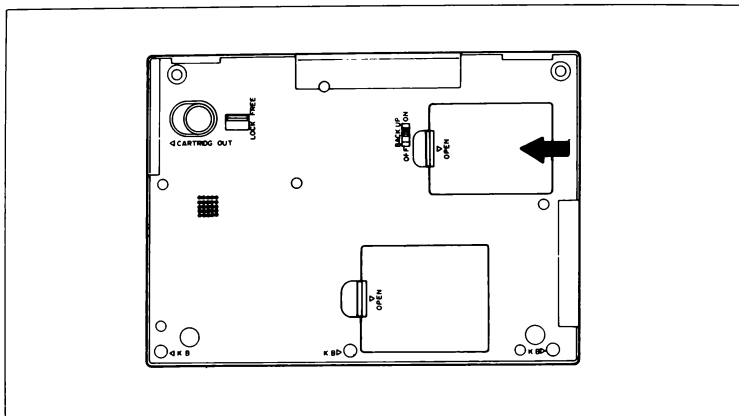
ROM Capsule Compartment

ROM capsules are installed in the ROM capsule compartment.
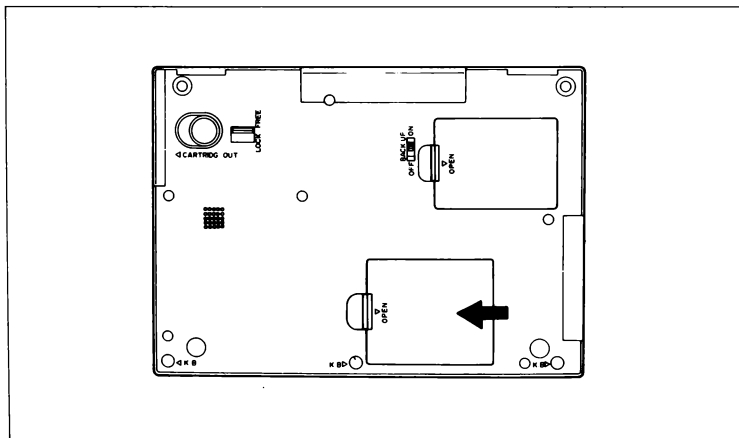
Reset Switch

The reset switch is not used during normal operation. However, it is used to reset the system when operation hangs up (stops due to an error which cannot be corrected by any other means). Use a ball point pen or the like to press this switch.
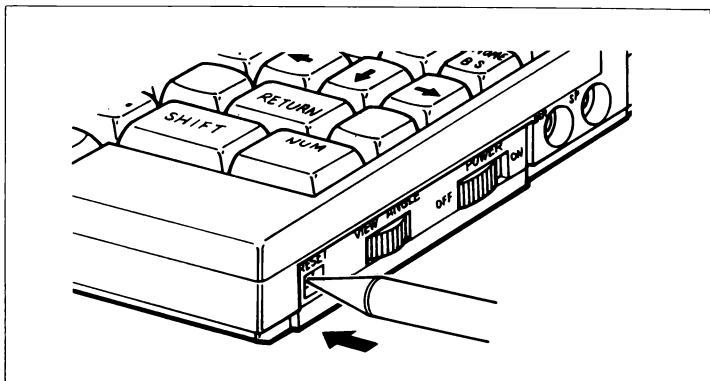
Power Switch

This switch is used to turn PX-4 on and off.
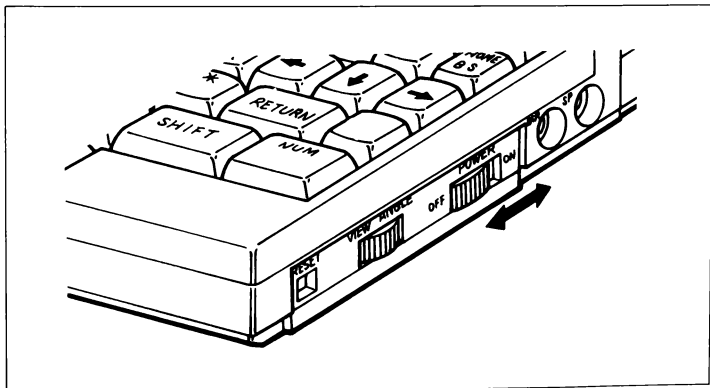
Interface Connectors

There are four interface connectors on the back panel.
The names of these connectors are as shown in the figure below.

(Back panel)

CASSETTE SERIAL RS-232C PRINTER ADAPTOR
PUSH

Printer interface
RS-232C interface
Serial interface
External audio cassette interface
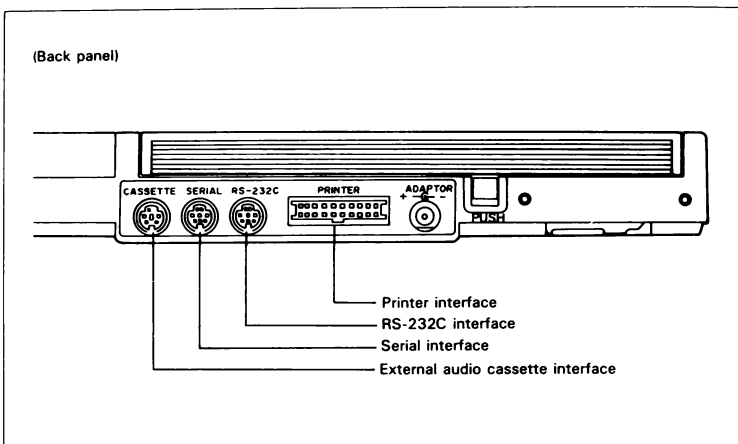
There are two interface connectors on the side panel as shown in the figure below.

(Side panel)

RESET VIEW ANGLE POWER BCR SP
OFF ON

External speaker output
Bar code reader
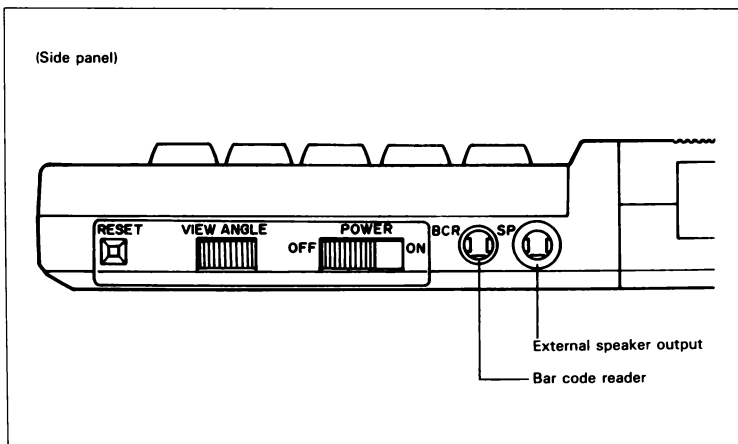
1.1.3 System configuration

The configuration of PX-4 is shown in the figure below.
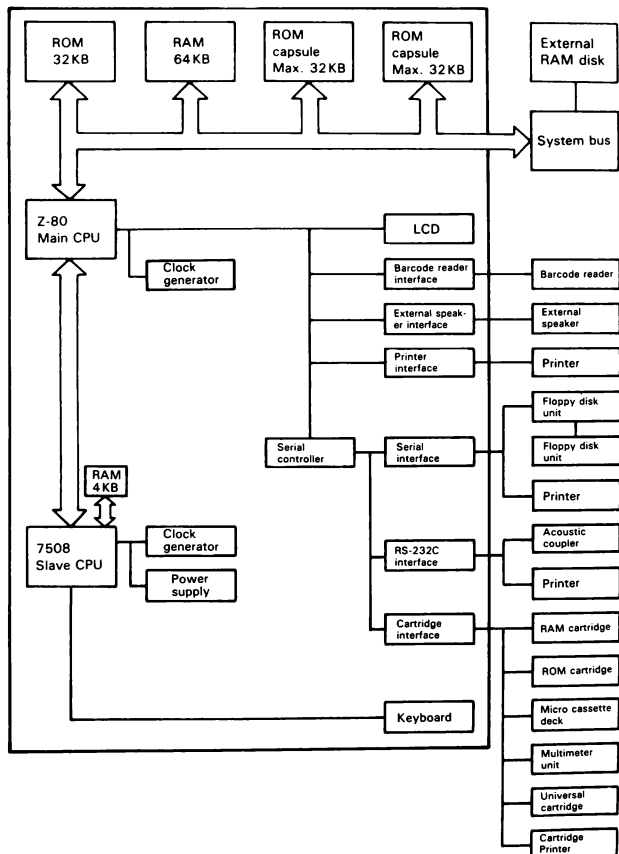
The figure below shows a representative configuration of the PX-4 system.

Acoustic coupler

Audio cassette recorder

Disk drive unit

Cartridge options

Terminal printer

Item keyboard

Bar code Reader
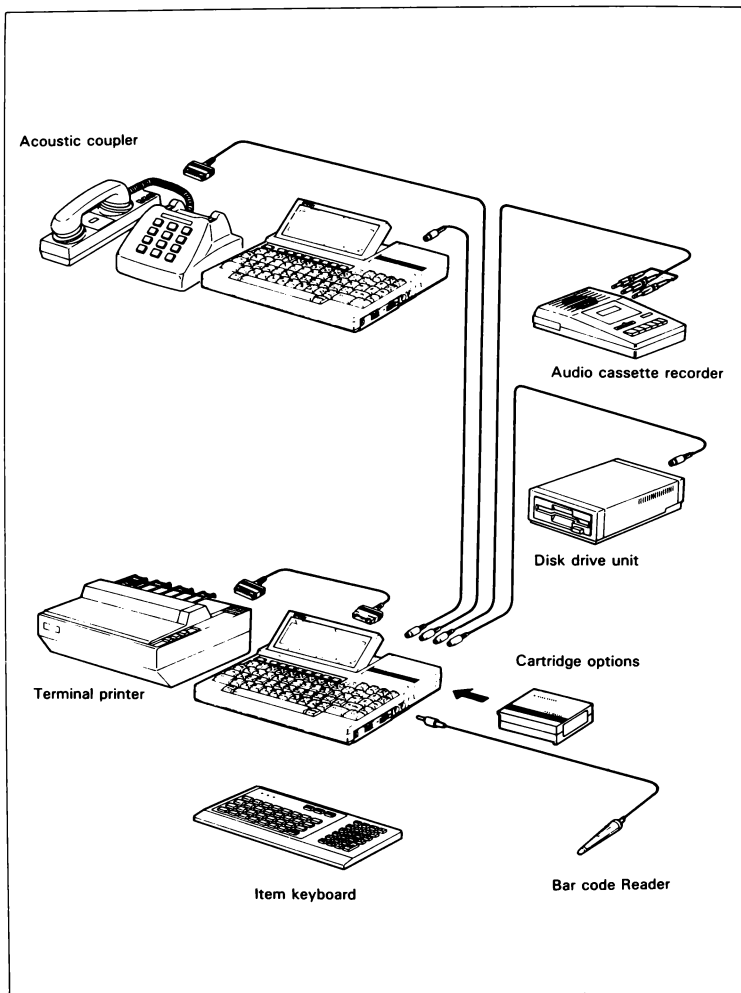
1.2 Hardware

The hardware of PX-4 consists of the following basic components.

> **Power supply**
> **CPU and memory**
> **Keyboard (Standard Keyboard or Item Keyboard)**
> **LCD screen**
> **RAM disk**
> **ROM capsules**

This section briefly explains these hardware components; for detailed specifications, see Appendix A, "Hardware Specifications." (For information on interfaces, see Chapter 3 "Standard Input/Output Interfaces"; for information on optional devices such as printers and floppy disk drives, see Chapter 4 "Optional Devices.")

Basic Hardware Configuration of PX-4

Auxiliary Memory Devices
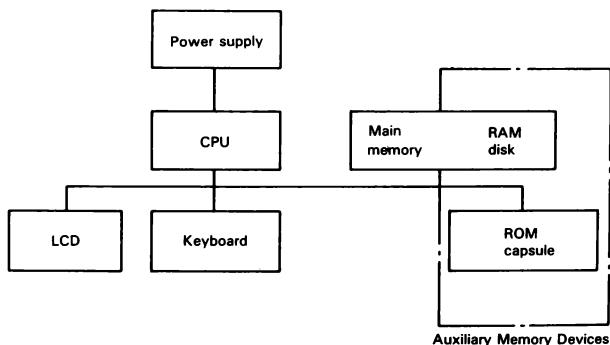
1.2.1 Power supply

PX-4 is equipped with two power supplies: a main supply (4.8V) and a sub battery (4.8V). Any of the following three units can be used as the main power supply.

- Dry cells (four AA batteries)
- NiCd battery pack
- AC power adapter

A NiCd battery pack and AC power adapter are supplied with PX-4 as standard accessories; dry cells must be purchased separately.

If the main power supply voltage drops below a certain level, the message

CHARGE BATTERY

is displayed to indicate that the batteries require charging or replacement. This condition is referred to as a power failure.

If this message is displayed while the NiCd battery pack is installed, connect the AC power adapter; if dry cells are being used, replace them.

See section 2.1, "Introduction to Operation" or section 2.9, "Battery Charging and Replacement" for battery charging and replacement procedures.

The sub battery provides the backup power supply for PX-4's main and slave CPUs. Power for memory backup is drawn from this battery only when a main battery power failure occurs. Since the contents of memory will be lost if the sub battery becomes discharged, be sure to replace or recharge the main batteries promptly.

The sub battery is rechargeable and can be used almost indefinitely; therefore, it ordinarily will not require replacement. The sub battery is recharged on power drawn from the main battery while PX-4 is turned on; if PX-4 is turned off, it is recharged only if the AC power adapter is connected.

1.2.2 CPU and memory

Two CPUs are used in PX-4: a Z-80 8-bit main CPU and a 7508 4-bit slave CPU. The slave CPU controls the keyboard and functions such as power supply.

Main memory assigned to the main CPU includes 32K bytes of ROM (read only memory), 64K bytes of RAM (random access memory), and up to 64K bytes of optional ROM in the form of ROM capsules (up to two 32K-byte ROM capsules).

However, since the CPU can only address 64K bytes of memory at one time (the addresses from 0 to 65535), the memory is divided up into banks as shown in the figure below and the CPU switches itself between banks to allow all of memory to be accessed.

System bank	Bank 0	Bank 1	Bank 2
		(Same as bank 0)	(Same as bank 0)
ROM 32KB	RAM 64BK	ROM capsule Max. 32KB	ROM capsule Max. 32KB
(Same as bank 0)		(Same as bank 0)	(Same as bank 0)
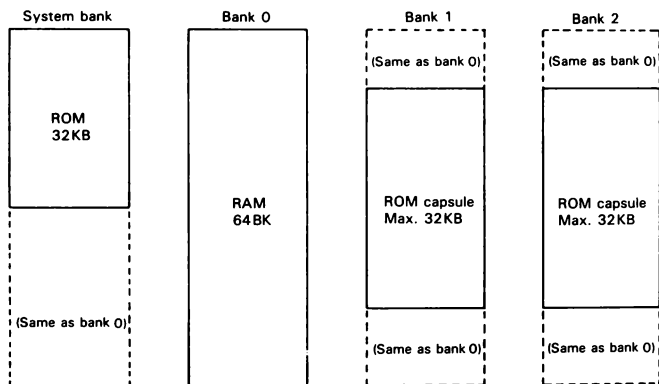
The system bank ROM contains the CP/M operating system and basic system programs. The RAM in bank 0 is used as work area and user area. The ROM in banks 1 and 2 contains utility programs. (In the standard PX-4, bank 1 holds the ROM which contains BASIC and bank 2 is empty.)

NOTE:
Utility ROM capsule can be installed into bank 2.

In addition to the above, 4K bytes of ROM are assigned to the slave CPU. This memory contains the software which controls slave CPU operation. The slave CPU operates constantly, regardless of the setting of the power switch.

1.2.3 RAM disk

With PX-4, part of main memory can be used for storage of files in the same manner as an external disk drive. Use of main memory for file storage makes it possible to access (retrieve or store) files much faster than is possible with conventional floppy disk devices. To increase work effeciency, use of the RAM disk is recommended for programs which use frequent disk access or which require random access to disk.

The contents of the RAM disk are managed using a directory in the same manner as with conventional floppy disks. The directory information is stored in the RAM disk, and contains information which is used to manage files. A maximum of 16 files can be stored in the RAM disk at one time.

Unless otherwise specified by the user, the size of the RAM disk is 26K bytes. However, the size can be changed in 1K byte increments to anywhere in the range from 2K bytes to 35K bytes. It is also possible to delete the RAM disk entirely by specifying its size as 0 bytes. The RAM disk size is specified during system initialization or using the CONFIG command which is included in the optional utility ROM.

Data stored in the RAM disk is maintained even when the power switch is turned off (this is referred to as "memory backup").

An optional 16KB RAM cartridge can be installed for use as an additional RAM disk. (See Chapter 4 "Optional Devices" for more information on the RAM cartridge and conventional floppy disk drives.)

Further, RAM disk capacity can be expanded to 128KB by installing an optional 128KB external RAM disk unit. In this case, RAM disk capacity (drive A) is fixed to 128K bytes.

1.2.4 Keyboard

One of the most prominent features of PX-4 is its keyboard, which can be easily removed and replaced with one of another type. Types of keyboards which can be used with PX-4 are the standard keyboard and the item keyboard. Several different versions of the standard keyboard are provided for different countries (the U.S., England, France, Germany, Denmark, Sweden, Norway, Italy and Spain). See section 4.2 "Keyboards" for keyboard replacement procedures.

The keyboard is controlled by the 7508 slave CPU. This releases the main CPU from the need to do keyboard processing and thus increases the speed with which other processing is performed.

PX-4's keyboard is equipped with a feature called the auto repeat function. This function makes it possible to enter the same character repeatedly simply by pressing and holding the corresponding key. When the item keyboard is installed, the auto repeat function is turned off until it is turned on by the user.

Standard Keyboard

PX-4's standard keyboard includes 72 keys which are grouped by function in a compact arrangement as shown in the figure below. Character keys are arranged in the standard typewriter keyboard layout. The key tops are sculptured, providing more positive "feel" for touch typing. Character sets supported include ASCII, English, French, and German Denmark, Sweden, Norway, Italy and Spain; depending on the system, the user can select from among these character sets.

See section 2.3 "Inputting Data from the Keyboard" concerning the types of keys and their uses.
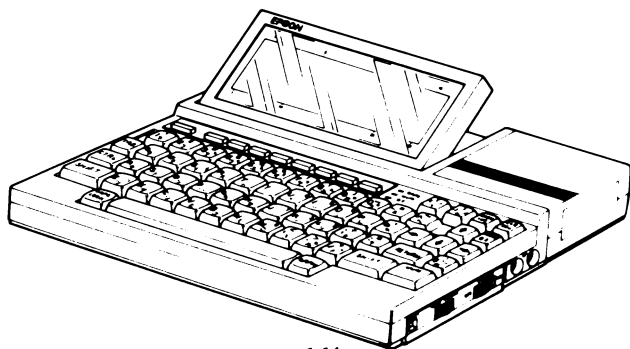
Item Keyboard

The item keyboard which can be installed on PX-4 is designed to make it easy to use PX-4 as a special purpose machine. Keys on the item keyboard are divided into two groups: the item key group and the numeric key group. The functions of all keys in the item key group can be defined by the user.

The item key group consists of 32 keys. The user can define 31 of these keys (keys other than the $\boxed{\text{SHIFT}}$ key) so that different strings of characters are input when keys are pressed. When using the item keyboard, write the key definitions on an overlay sheet and place it and a transparent overlay over the keyboard.
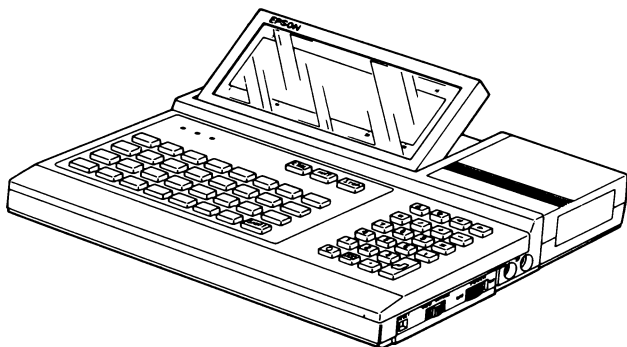
Keys on the standard keyboard can also be defined for use as item keys. See Appendix E "Programmable Function Keys and Item Keys" and the explanation of the KEY command in the BASIC Reference Manual for procedures for doing this.

1.2.5 Liquid crystal display

PX-4's LCD screen can display up to 8 40-character lines or up to 240 × 64 dots of graphics. For applications which require larger display capacities, the concept of a virtual screen has been introduced to increase the effective screen capacity to up to 25 80-character lines. See section 2.5 "Virtual Screen and Window Screen" for an explanation of the virtual screen.
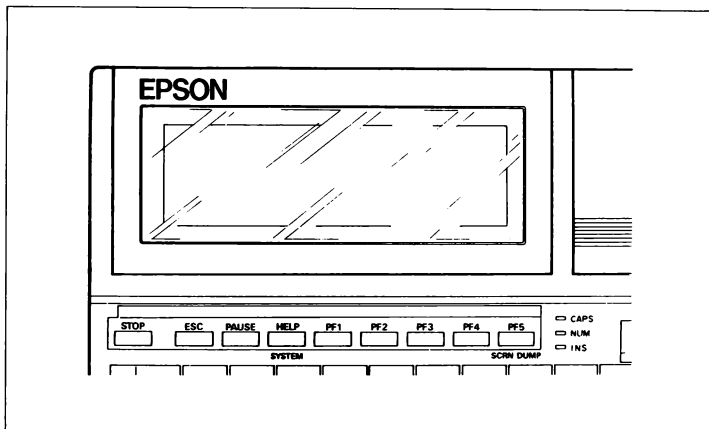
1.2.6 ROM capsules

ROM capsules in the ROM capsule compartment in the bottom of PX-4 can be used as an auxiliary storage device in much the same manner as the RAM disk.

Unlike the RAM disk, a ROM capsule provides read-only storage; in other words, data or files can be read from the ROM capsule, but cannot be written to it. Application programs such as BASIC are provided in the form of ROM capsules.
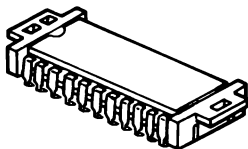
Drive names are assigned to ROM capsules in the same manner as with floppy disk drives and the system handles ROM capsules as if they were disks.

<ROM formats>

Two different types of ROM formats may be used with PX-4. With one format, programs in ROM are executed directly (without being loaded into main memory); with the other, programs are loaded into main memory for execution. With the former format, ROMs must be installed in a ROM capsule for use; with the latter, ROMs may be installed either in a ROM capsule or in a ROM cartridge.

BASIC is provided in directly executable format, while programs in optional utility software ROMs are loaded into memory for execution. (The utility ROM contains transient commands and applications.)

1.3 Software

1.3.1 Operating system (enhanced CP/M Version 2.2)

The operating system used with PX-4 is an enhanced version of CP/M Version 2.2. The operating system is software which intermediates between the hardware of a computer and application programs, and which unifies the computer system and performs overall control.

The operating system performs all processing required for file management and input/output access to peripheral devices, making it unnecessary for the user to be concerned with the details of such operations when developing application programs.

```
                    ┌──────────────────────────┐
                    │  CP/M operating system   │
                    └──────────────────────────┘
                                 │
           ┌─────────────────────┼─────────────────────┐
    ┌──────────────┐      ┌──────────────┐      ┌──────────────┐
    │   BASIC      │      │   CP/M       │      │ Application  │
    │ interpreter  │      │ transient    │      │ programs     │
    │              │      │ commands     │      │              │
    └──────────────┘      └──────────────┘      └──────────────┘
           │
    ┌──────────────┐
    │ User programs│
    └──────────────┘
```
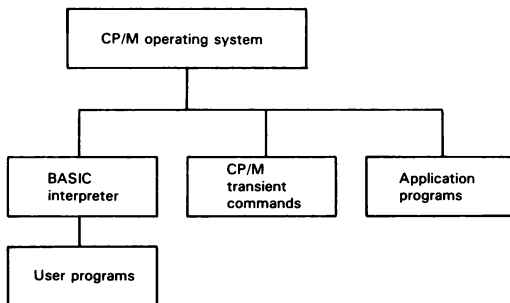
Standard CP/M is designed as a floppy disk operating system and does not support ROM capsules, RAM disk, or a microcassette drive. Therefore, CP/M used with PX-4 has been enhanced to provide support for these devices.

Further, standard CP/M is distributed on floppy disks, but CP/M for PX-4 is provided in ROM as part of main memory. Therefore, it is not possible to modify the contents of PX-4 CP/M.

< What is CP/M? >

The term CP/M stands for "control program for microprocessors," and refers to a floppy disk operating system (FDOS) which was developed by Digital Research, an American corporation, for 8-bit microcomputers. The CP/M operating system cannot be used with all 8-bit microcomputers, but only those which are based on the 8080, 8085, or Z-80 series of CPUs. (The CPU used in PX-4 is a Z-80.)

Currently, CP/M is widely accepted as the standard operating system for 8-bit microcomputers, and is used in many personal computers. Use of a standard operating system greatly increases the variety of application programs which can be used with a machine.

Some of the commands which are used under CP/M are as follows.

DIR.....................	Displays the contents of the file directory.
ERA.....................	Used to erase disk files.
REN.....................	Used to rename disk files.
TYPE...................	Used to display the contents of disk files.
SAVE...................	Used to save the contents of memory to a disk file.
USER...................	Used to select a user area.

For example, the directory for files in drive A: can be displayed by entering the DIR command as follows.

DIR A:

The following is an example of use of the REN command to change the name of file OLD.BAS in drive A: to NEW.BAS.

REN A:NEW.BAS = OLD.BAS

Drive names and file names must be specified in the above manner with most CP/M commands. This part of the command is referred to as the file descriptor. This file descriptor consists of a drive name, file name, and file name extension.

X:XXXXXXXX.XXX

File name extension
File name
Drive name

CP/M commands and file descriptors are explained in detail in section 2.7 "CP/M Commands."

When CP/M starts operating, a prompt is displayed on the screen as shown below.

```
A>
```
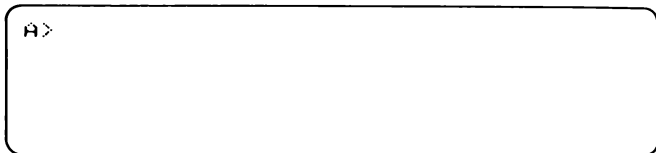
When a command is input from this screen, the corresponding program is loaded into the transient program area (TPA) in main memory from auxiliary storage and executed. All application programs which are executed under CP/M are recorded in auxiliary storage as files with the file name extension .COM. These are "program files"; i.e., machine language files which can be executed directly by the computer.

To execution an application, enter its file name, but do not type in the file name extension .COM (for example, to execute B:BASIC.COM, input B:BASIC).

When execution of the application is completed, control is returned to CCP and the screen shown above appears.

```
         ┌─────────────────┐
         │  CP/M start-up  │
         └─────────────────┘
                  │
  ┌───────────────┤
  │       ┌───────────────┐                              ⎫
  │       │ CCP screen,   │                              │
  │       │ A > ▨         │                              │
  │       └───────────────┘                              │
  │               │                                      │
  │       ┌───────────────┐                              │
  │       │ Command input │                              │  CCP mode
  │       └───────────────┘                              │
  │               │                                      │
  │       ┌───────────────┐      ┌──────────────────┐    │
  │       │ Program started│ ◁══ │  C : BASIC. COM  │    │
  │       └───────────────┘      └──────────────────┘    ⎭
  │               │                                      ⎫
  │       ┌───────────────┐                              │  Application
  │       │   Execution   │                              │  program mode
  │       └───────────────┘                              │
  │               │ Completion                           ⎭
  └───────────────┘
```
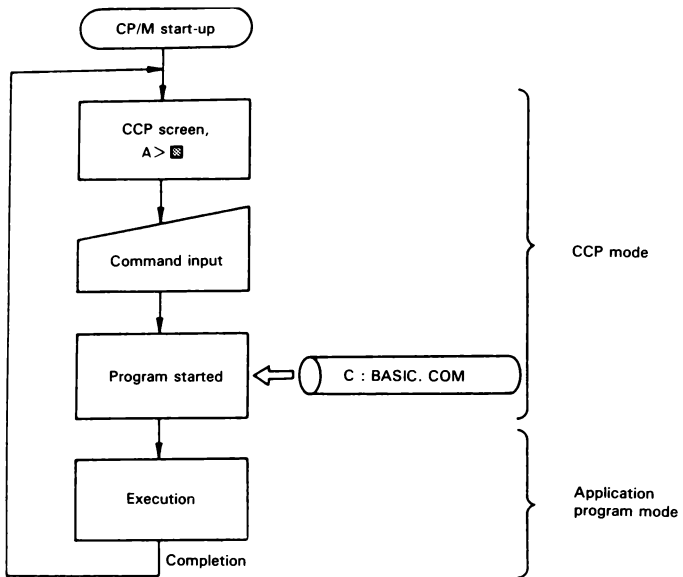
The internal structure of PX-4's operating system is shown in the figure below.
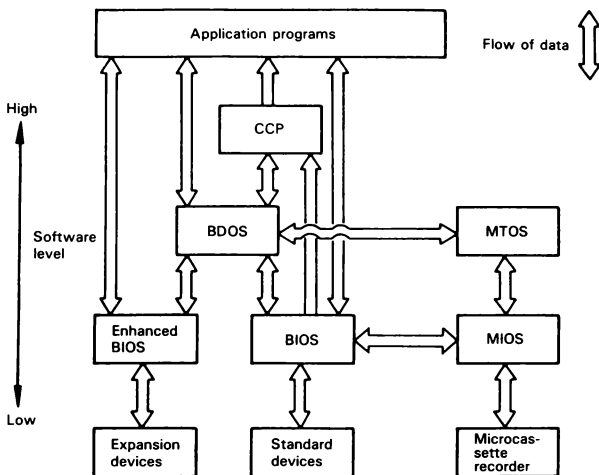
Elements at the top of this figure are at higher software levels (closer to the person using the computer) and those at the bottom are at lower software levels (closer to the machine). The elements are explained below.

CCP (console command processor)
Inputs commands from the console, loads corresponding application programs, and executes those programs.

BDOS (basic disk operating system)
Manages RAM disk and floppy disk files.

BIOS (basic input/output system)
Provides the software interface for input/output access to standard devices.

MTOS (microcassette tape operating system)
Includes the transient commands of CP/M, programs such as BASIC, and user-written programs.

Enhanced BIOS

Provides the software I/O interface between CP/M and expansion devices. System operation (see section 2.5 "System Operation") is controlled by enhanced BIOS.

Devices managed by standard BIOS include the keyboard, LCD screen, and floppy disk drives, and those managed by enhanced BIOS are the speaker, RS-232C interface, clock, serial port, ROM capsules, RAM disk, ROM cartridges, RAM cartridges, microcassette drive, and cartridge printer.

Currently, CP/M is widely accepted as the standard operating system for 8-bit microcomputers, and is used in many personal computers. Use of a standard operating system greatly increases the variety of application programs which can be used with a machine.

1.3.2 BASIC

PX-4 uses Microsoft BASIC, an interpreter which is widely accepted as standard for use with microcomputers. The interpreter has been enhanced by EPSON to provide a variety of powerful new functions, including a time control function and a communication function. Other features which have been added to provide greatly increased operability are as follows.

- Division of the BASIC program area into five segments, allowing up to five BASIC programs to be present in memory at the same time.
- Addition of an edit mode which can be used together with the screen editor to increase the speed and efficiency with which programs can be modified.

For details on BASIC, see the BASIC Reference Manual.

NOTE:
BASIC can only be used when installed in a ROM capsule; it cannot be used in ROM cartridge form.

1.3.3 Utility ROM (optional)

The utility ROM contains transient CP/M commands such as PIP and STAT and application programs such as CONFIG, TERM, and FILINK. The CONFIG program is used to set a variety of PX-4 operating parameters, and programs such as TERM and FILINK make it possible to use PX-4 as a terminal with a host computer or to transfer programs between PX-4 and another computer. See Chapter 5 for detailed explanations of these programs and procedures for using them. The utility ROM can be used either in a ROM capsule or a ROM cartridge.

Chapter 2

OPERATION

This chapter provides information which is required in order to actually make effective use of PX-4. It starts with an explanation of procedures for starting and ending operation and goes on to discuss data input, system operation, and the CP/M commands. This is probably the part of the manual which you will refer to most frequently as you become familiar with PX-4.

It is not necessary to try to memorize the commands and operating procedures. If you forget a command, simple open the manual to this chapter and review the section which applies. After doing this several times, you will learn naturally absorb the information you need to know.

2.1 Introduction to Operation

This section describes procedures for actually starting PX-4 operation after you have removed it from its carton. Follow the procedures carefully and do one step at a time.

Step 1:   Battery installation
PX-4 can be operated using dry cells. If you will be using dry cells, install them as follows.

1. Verify that the power switch is set to OFF.
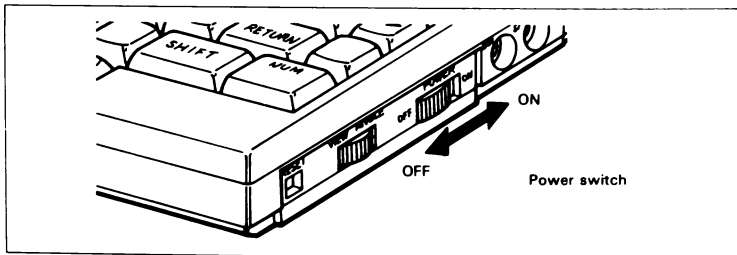
2. Next, set the battery backup switch on the bottom of PX-4 to the ON position.
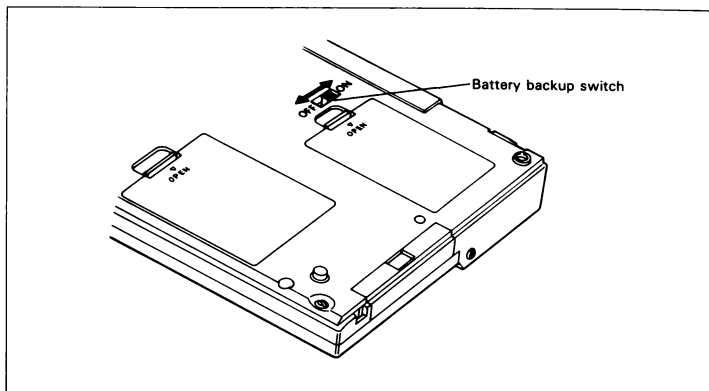
Here, "battery backup" refers to the supply of power to memory to maintain the contents of memory while the main power is off. Unless you will not be using PX-4 for an extended period of time, leave the battery backup switch set to ON at all times.

NOTE:
See section 2.9 for using NiCd battery pack and AC adapter.

3. Open the battery compartment and insert four dry cells as shown in the figure below. (Be sure to use AA-size cells and make sure that the polarity is correct.)
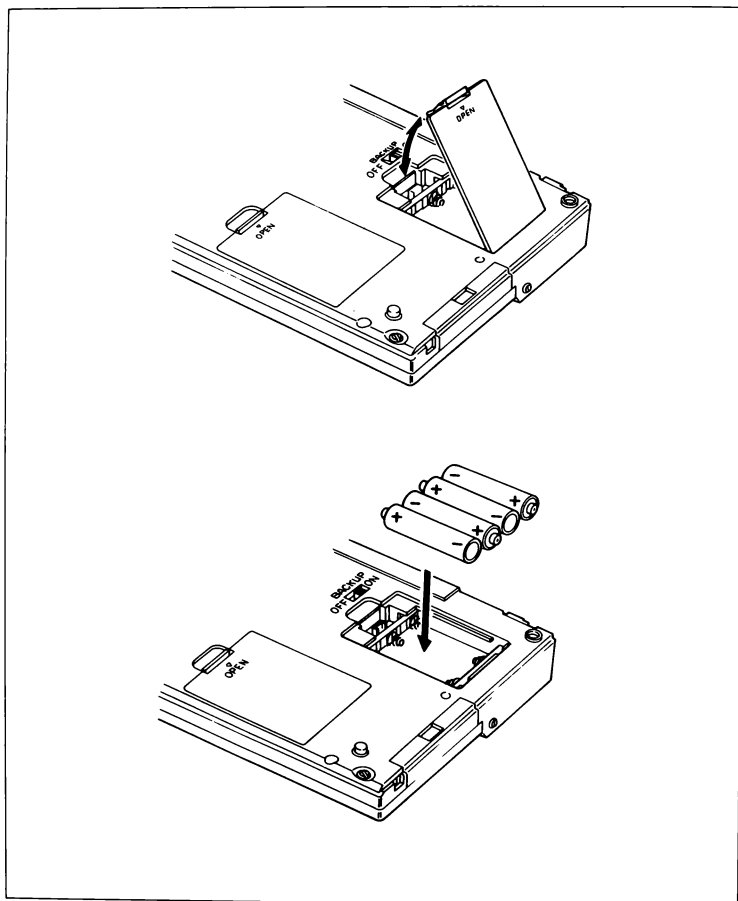
4. Close the battery compartment.

Step 2: System initialization

1. Open the ROM capsule compartment on the bottom of PX-4.
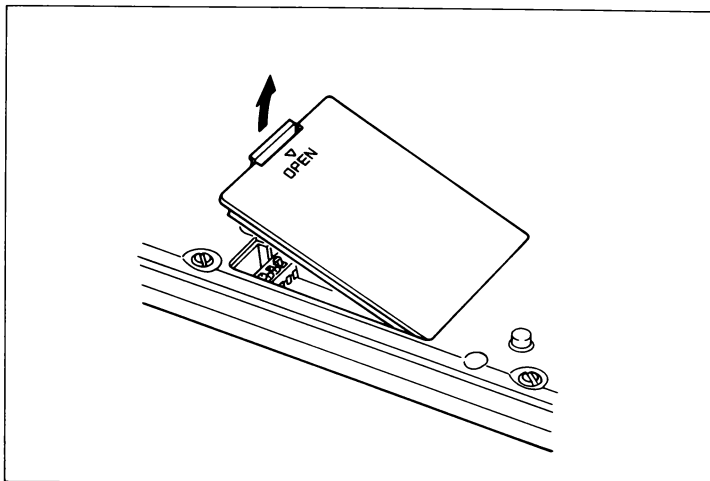
2. Press the 7508 slave CPU reset switch which is located inside the ROM capsule compartment.
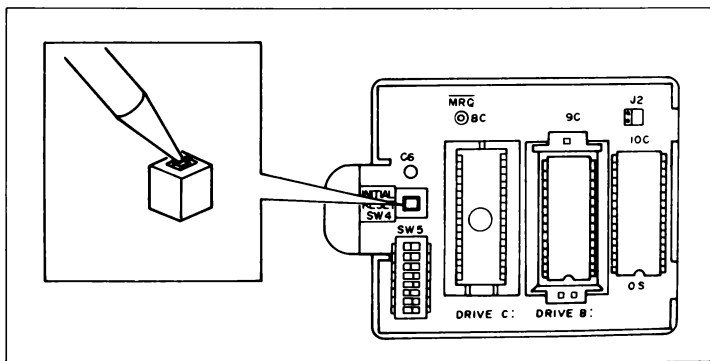
3. Close the ROM capsule compartment.
4. Turn on the power switch.
5. Verify that the SYSTEM INITIALIZE screen is displayed. This screen appears as shown below.

```
SYSTEM INITIALIZE
DATE/TIME (MMDDYYhhmmss)  000000000000
```

If the characters which appear on the screen at this time are not easy to read, raise the LCD screen and adjust contrast by turning the VIEW ANGLE control knob.

6. Input the current date and time. When doing this, enter the hour as a number from 1 to 24 (PX-4's clock function uses the 24-hour system). If you accidentally enter an incorrect number, you can correct the entry by moving the cursor with the $\boxed{\leftarrow}$ and $\boxed{\rightarrow}$ keys. After typing in the date and time, press the $\boxed{\text{RETURN}}$ key; this sets the date and time to PX-4's calendar/clock. For example, if the date is May 30, 1984 and the time is 15:37:40, enter as follows.

```
SYSTEM INITIALIZE
DATE/TIME (MMDDYYhhmmss)  053084153740
```

7. After the date and time have been input, the screen changes as shown below.

```
SYSTEM INITIALIZE
DATE/TIME (MMDDYYhhmmss)  053084153740
WEEK (0 to 6) 0
```

Now enter the day of the week as a number from 0 to 6.
Correspondence between numbers and days of the week is as follows.

0	1	2	3	4	5	6
SUN	MON	TUE	WED	THU	FRI	SAT

Since we are assuming that the date is May 30, 1984, type in 3 for Wednesday and press the RETURN key.

```
SYSTEM INITIALIZE

DATE/TIME (MMDDYYhhmmss) 053084153740
WEEK (0 to 6) 3
```

8. After the day of the week has been entered, the screen changes as shown below.

```
SYSTEM INITIALIZE

DATE/TIME (MMDDYYhhmmss) 053084153740
WEEK (0 to 6) 3
RAM DISK SIZE (×1  kB) 26
```

At this point you can specify the RAM disk size (the amount of memory which is used as RAM disk) as a 1- or 2-digit number from 02 to 35K bytes (01 cannot be specified). If 00 is specified, the RAM disk size is set to 0 and the RAM disk cannot be used. The number "26" which is displayed on the screen indicates the default RAM size (the size which is used if no other number is specified). This value is set automatically if the RETURN key is pressed without entering any number. The message "RAM DISK SIZE (1 kB) 26" is not displayed when the external RAM disk unit is installed. (RAM disk capacity is fixed to 128K bytes.)

9. For the time being, leave the RAM disk size unchanged; just press the [RETURN] key. After doing so, the screen changes again as shown below.

```
SYSTEM INITIALIZE

DATE/TIME (MMDDYYhhmmss) 053084153740
WEEK (0 to 6) 3
RAM DISK SIZE (×1 kB) 26
USERBIOS SIZE (×256 B) 000
```

The size of the user BIOS area can be specified as a 1, 2, or 3 digit number (indicating a multiple of 256 bytes). The sum of the RAM disk size and the user BIOS area size must not be greater than 35.5K bytes. The "000" displayed on the screen is the system default value (the setting which is used if no other size is specified). For the present, do not specify a user BIOS area size. Just press the [RETURN] key; this ends system initialization and starts CP/M.

NOTES:
1. *The system may not operate properly if invalid data is entered during system initialization (for example, if 7 is specified for the day of the week). If you press the return key after accidentally entering an incorrect number, do system initialization over again from the beginning.*
2. *See Appendix C "BIOS Subroutines" for information pertaining to user BIOS.*

Step 3: Running application programs (e.g., BASIC)

1. The following menu screen is displayed after [Step 1] and [Step 2] above have been completed.

```
 ##.#k CP/M    05/30 (SUN) 15:45:59   1/1
B:BASIC
B:BASIC        COM
```

(Numbers displayed at ##.# indicate the memory size of CP/M.)

This screen can be thought of as a list which indicates what application programs are included on the currently selected disk. (See 2.4.2 "MENU screen" for details on the functions of this menu and procedures for using it.)

When several file names are displayed in the menu, the file desired can be selected using the cursor control keys. The name of the selected program (file) is shown in reverse display and displayed on the command line. Now, select BASIC and press the [RETURN] key.

2. When the [RETURN] key is pressed, characters on the command line are passed to the console command processor and the appearance of the screen momentarily changes as shown below.

```
A>B:BASIC
```

This shows that CP/M is starting BASIC from drive B:.

3. After BASIC has been started, the BASIC start-up menu is displayed as shown below.

```
BASIC Ver#.# (C) 1983 Microsoft & EPSON
RETURN to run or SPACE to login.
         P1:               0 Bytes
         P2:               0 Bytes
         P3:               0 Bytes
         P4:               0 Bytes
         P5:               0 Bytes
              ***** Bytes Free
```

(The numbers indicated for # . # in this screen indicate the version number of BASIC, and those displayed for * * * * * indicate the amount of memory which is available for use by BASIC.)

Select one of BASIC's five program areas by using the ↑ and ↓ keys to move the cursor up or down. If the space key is pressed, the selected program area is logged in and BASIC stands by for input of commands; if the RETURN key is pressed, the selected program area is logged in and any program in that area is executed automatically.

See the BASIC Reference Manual for an explanation of the program areas and procedures for using BASIC.

2.2 Start-Up and Shut-Down

This section describes PX-4's start-up and shut-down sequences. Here, the meanings of "start-up" and "shut-down" are as follows.

Start-up: Refers to start-up of the CP/M operating system when PX-4's power is turned on. One of PX-4's various start-up screens is displayed when CP/M operation is started.

Shut-down: Refers to shut-down of PX-4's power and termination of operation. After shut-down, nothing is displayed on the LCD screen.

Usually, PX-4 is started simply by turning on the power switch. However, it is also possible to set PX-4 to start itself automatically at a preset time. (This is referred to as the wake function. See 2.5.2 "Wake" for an explanation of this function.)

When PX-4 is started, a MENU screen is displayed. Programs are executed by moving the menu cursor to the name of the program which is to be executed, then pressing the [RETURN] key. If you want to go from the MENU screen to the CCP screen, press the [ESC] key.
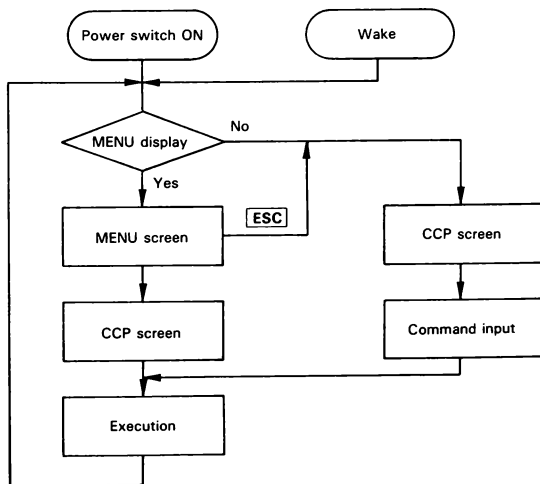
Whether or not the MENU screen is displayed is specified from the System Display as described in 2.4.4 "System Display."

PX-4 operation is shut down when the power switch is set to OFF or when a specific amount of time has passed since the last key entry was made. In the latter case, the power is turned off automatically by PX-4's power-off function. (See 2.5.4 "Automatic power-off for details on this function.)

<Power off states . . . . . The restart mode and the continue mode>
PX-4 enters one of two states when the power is turned off. These states are referred to as the restart mode and the continue mode.
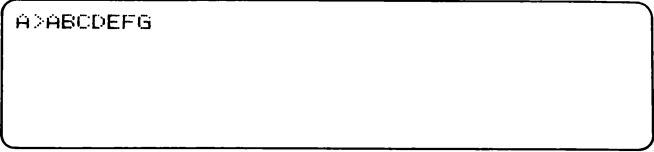
The <u>restart mode</u> is the mode in which the CCP screen is displayed when the power switch is turned on. (If the MENU screen display function is turned on, the MENU screen is displayed instead of the CCP screen; if BASIC is active, the BASIC initial screen is displayed.) When the power is turned off in the restart mode, display information and information concerning input in progress is lost and the start-up screen is displayed the next time the power is turned on.

The <u>continue mode</u> is the mode in which display and input information, etc., is preserved and operation resumes at the point at which it was interrupted when the power switch was turned off. This is shown by example below. Do this examples as described and note the difference which occurs when the power is turned on from the continue mode.

1. Turn on the power switch and display the CCP screen (if the MENU screen is displayed, go to the CCP screen by pressing the $\boxed{\text{ESC}}$ key). The screen should appear as shown below.

```
A>
```

2. When the CCP screen is displayed as shown above, type in some letters from the keyboard (any letters will do), but do not press the RETURN key.

```
A>ABCDEFG
```

3. Turn off the power switch while pressing the CTRL key (this turns off the power in the continue mode), then turn the power switch back on again. When the power switch is turned on, the speaker beeps and data displayed on the screen when the power was turned off is displayed again. If any further keys are pressed at this point, they will appear following the characters which were input before the power was turned off.

Conditions under which the power goes off in the continue mode (under which previous conditions are maintained the next time the power switch is turned on) are as follows.

- When the power switch is turned off while pressing the CTRL key
- When the power is turned off by the auto power-off function
- When the power switch is turned off during execution of a BASIC program
- When a power failure occurs
- When the power switch is turned off while the item keyboard is installed

2.3 Inputting Data from the Keyboard

Either of two types of keyboards can be used with PX-4: the standard keyboard or the item keyboard. This keyboards are described below.

Standard keyboard

The standard keyboard has 72 keys. These keys are devided into four groups by function as follows.

Alphanumeric keys (50 keys)
The alphanumeric keys are used to input letters, numbers, and graphic characters.

Function keys (9 keys)
The function keys are definable; that is, commands and functions can be assigned to them by the user.

Editing keys (7 keys)
These keys are used for screen editing and control.

Mode keys (6 keys)
These keys are used to switch input between the alphanumeric and graphic input modes.
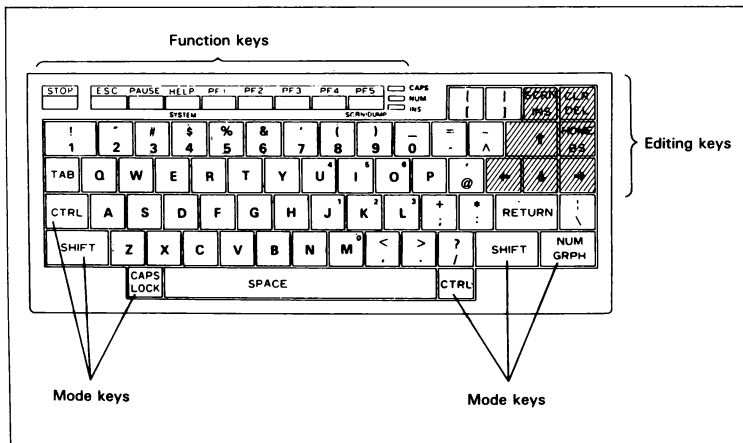
Item keyboard

The keys on the item keyboard are divided into four groups by function as follows.

Item keys (32 keys) and SHIFT key (1 key)

Except for the SHIFT key, all of these keys are redefinable. The initial key definitions (those set when the system is initialized) are as shown in the figure below.

Numeric keys (19 keys)

Included among the numeric keys are keys used for inputting numbers and arithmetic operators, and the RETURN key.

Cursor control keys

These keys are used to move the cursor.

System keys (3 keys)

These keys are used to reset the system and for input/output control.
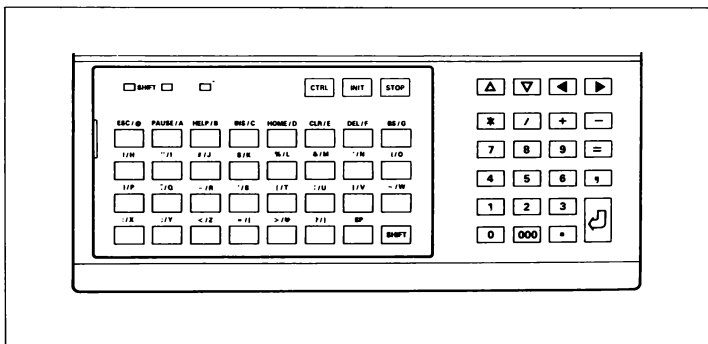
There are three LED indicators on the item keyboard. One of these indicates the current SHIFT state, and the other two are provided for use by the user. Procedures for lighting and turning out the LEDs are described in Appendix E "Programmable Function Keys and Item Keys" in the BASIC Reference Manual.

2.3.1 Input procedures when using the standard keyboard

This section describes procedures for inputing data (letters, numbers, and graphic characters) and for using the function keys.

Before trying to input any data, prepare for input as follows.

1. Display the CCP screen. At this point, PX-4 is in the data input mode (the mode in which PX-4 accepts character input when keys are pressed.)
2. Verify that the three LEDs located next to PF5 are not lit.

   If any of the LEDs are lit, turn them out as follows.
   If the CAPS LED is lit, press the CAPS LOCK key.
   If the NUM LED is lit, press and hold the SHIFT key, then press the NUM key.
   If the INS LED is lit, press the INS key.

When the standard keyboard is installed, the following three modes can be selected by pressing the mode selection keys. Characters input when keys are pressed correspond to the input mode being used at the time.

(1) Alphanumeric modes ——————— Normal mode
                              ————— CAPS LOCK mode
                              ————— Numeric mode

(2) Graphic mode

(1) Inputting alphanumeric characters and symbols (alphanumeric modes)

Basic procedures for switching the keyboard input mode are as follows.

Normal mode

None of the keyboard LEDs are lit while the keyboard is in the normal mode. Characters which can be input in this mode are as follows.

> **Lowercase letters (a to z) and spaces**
> **Numerals (0 to 9)**
> **Alphanumeric symbols ([ ] − @ ; : , . / \\)**

The mode in which these characters can be input is referred to as the alphanumeric normal mode. In other words, the character which is input when a key such as that shown in the figure at right is pressed is that which appears at the bottom of the key face (3). If the key pressed is an alphabetic key, a lowercase letter is input. To see this, try pressing the following keys in sequence.
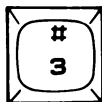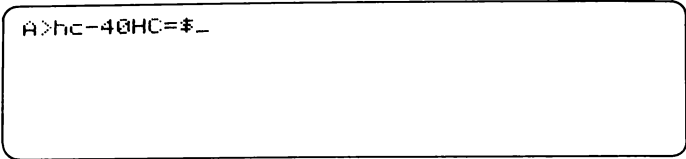
After pressing these keys, the screen appears as shown below.

```
A>hc-40
```

NOTE:
If you accidentally press an incorrect key, press the HOME/BS key. This moves the cursor one space to the left and deletes the last character entered. Carefully press the keys one at a time.

Next, press the same keys again while hollding the [SHIFT] key. After doing this, the screen should appear as shown below.
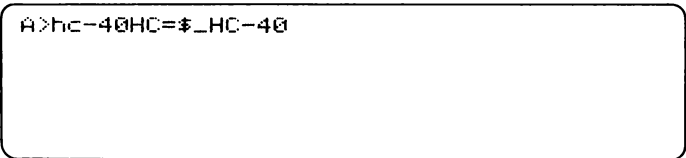
```
A>hc-40HC=$_
```

As you can see, pressing alphabetic keys together with the [SHIFT] key causes uppercase letters to be input; pressing keys such as that shown at right causes the character printed at the top of the key (#) to be input.
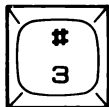
CAPS LOCK mode
Now press the [CAPS LOCK] key (the key to the right of the space bar); this causes the CAPS LED to light and switches the keyboard to the alphanumeric CAPS LOCK mode. After switching to this mode, press the above keys in sequence again. The screen should now appear as follows.

```
A>hc-40HC=$_HC-40
```

This mode is almost the same as the alphanumeric normal mode, but uppercase letters are input when alphabetic keys are pressed by themselves, and lowercase letters are input when they are pressed together with the [SHIFT] key. To switch back to the alphanumeric normal mode, press the [CAPS LOCK] key again.

The table below summarizes procedures for inputting data in the alphanumeric modes.

Table of keyboard modes

LED	Key input	Input data
☐ CAPS ☐ NUM ☐ INS	[A]	a
	[SHIFT] + [A]	A
	[! 1]	1
	[SHIFT] + [! 1]	!
☀ CAPS ☐ NUM ☐ INS	[A]	A
	[SHIFT] + [A]	a
	[! 1]	1
	[SHIFT] + [! 1]	!

Numeric mode

Certain keys on the keyboard have a special function when they are pressed while the keyboard is in the numeric mode. If you work with numbers frequently, you will find it convenient to learn to use these special keys.

To enter the numeric mode, press the [SHIFT] key together with the [NUM] key. In this mode, the NUM LED lights. Characters which can be input and the keys used to input them are as shown in the figure below.
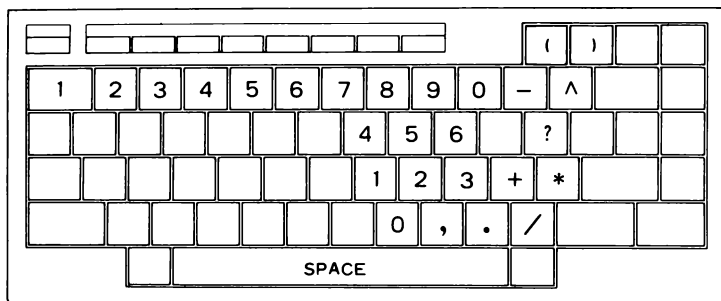
(2) Graphic character input (graphic mode)

Although the key faces are not marked with graphic characters, such characters can be input using the keys shown in the figure below.
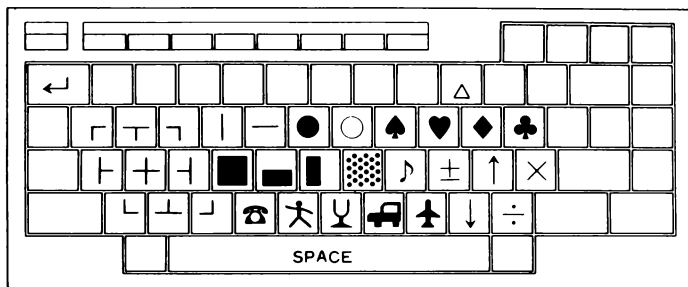
To input a graphic character, press the key to which that character is assigned together with the GRPH key. For example, if the V key is pressed together with the GRPH key, the character " ☎ " is input.

Unlike other modes, the keyboard cannot be locked in the graphic mode. (Graphic characters can only be input while the GRPH key is being pressed.)

Although basic procedures for switching the keyboard mode are as described above, it is also possible to switch modes in a variety of other ways which are dependent on the mode being used at the time. These procedures are illustrated in the figure below.
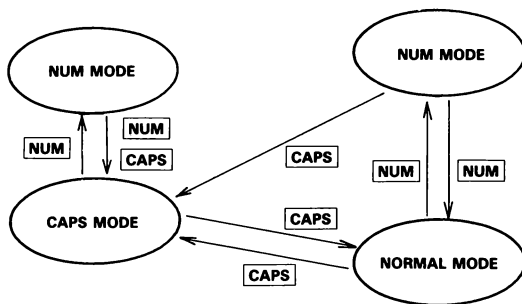
In this figure, $\boxed{\text{NUM}}$ indicates that the $\boxed{\text{NUM}}$ key is to be pressed while holding the $\boxed{\text{SHIFT}}$ key. The graphic input mode can be entered from any other mode simply by pressing the $\boxed{\text{GRPH}}$ key.
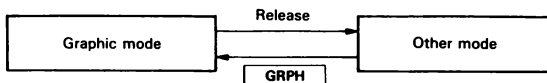
(3) Using the function keys

The function keys are the nine narrow keys at the upper left of the keyboard. These keys are used to input predetermined system commands or BASIC statements.

The keys marked PF1 to PF5 are called programmable function keys. The word "programmable" indicates that the user can assign his own commands to these keys, making it possible to input an entire command with one key stroke. When necessary, a return code (code 0DH) can be included with the characters making up the command assigned to a key.

With the System Display function keys PF1 to PF5 are used for manual control of PX-4's microcassette drive.

Commands assigned to function keys PF1 to PF5 can be changed with the KEY statement of BASIC or the CONFIG command which is included in the optional utility ROM.
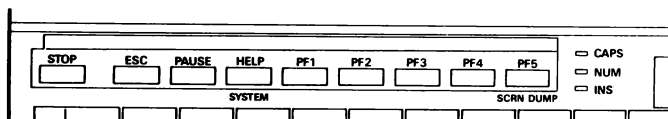
The initial definitions of function keys PF1 to PF5 for the various modes and screens are as shown in the table below.

Key Mode	PF1	PF2	PF3	PF4	PF5
Menu & CCP	dir/ config ↵	type/ submit	stat/ term ↵	pip/ filink ↵	basic/
BASIC	auto/ load"	list/ save"	edit/ system	stat/ menu ↵	run ↵/ login
System Display	< < —/rem	< —/mou	▓/dint	—> >/era	000/

NOTES:

1. In the table above, commands indicated to the left of the slash mark (/) are input by pressing the indicated key in the normal mode. Those indicated to the right of the slash mark are input by pressing the indicated key while holding the SHIFT *key. The* ↵ *symbol indicates a return code.*

2. *With the System Display, function keys* PF1 *to* PF5 *are effective only when the optional microcassette drive is installed.*

In the CP/M mode, the function keys marked STOP and PAUSE are used to control system operation. The ESC and HELP keys are used to switch between screens and modes of operation. Key functions are as follows.

STOP .... Interrupts execution of CP/M commands or BASIC programs and places the system in the command input mode.

PAUSE .... Momentarily stops execution of CP/M commands or BASIC programs. Execution is resumed when any key other than SHIFT, CTRL, CAPS LOCK, or STOP is pressed.

ESC .... While in the System Display, pressing this key returns display to the screen which was displayed before entering the System Display.

CTRL + HELP .... Except during system initialization, pressing these keys causes the System Display to appear on the screen.

CTRL + STOP .... Pressing these keys forcibly terminates program execution and any input/output operations which are in progress, then returns the system to the command input mode.

Function key strips which are provided with PX-4 can be inserted under the plastic plate above the function keys to identify them. Function key strips are provided for the CCP screen and BASIC screens. Blank strips are also provided; these can be marked with function key definitions made by the user.
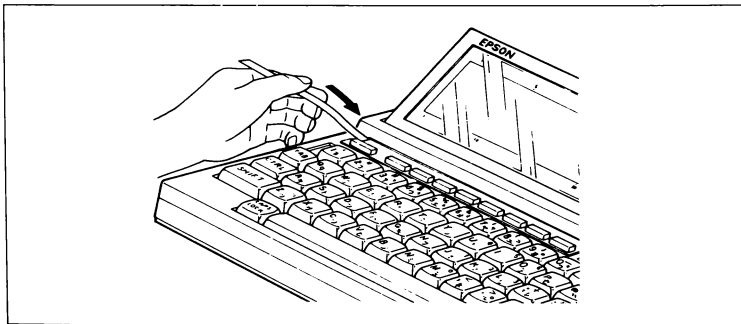
2.3.2 Input procedures when the item keyboard is installed

This section explains procedures for keying in data when the item keyboard is installed on PX-4. Types of keys on the item keyboard are as follows.

Item keys

The keyboard includes 31 item keys which can be defined by the user and a shift key which is used to shift the functions of the item keys. Any string of characters can be assigned to the item keys, making it possible to design easy-to-use systems for special-purpose applications.

However, initial values are assigned to the item keys during system initialization to make it easy to prepare and run application programs. The initial values assigned include alphanumeric characters and control codes, and are set whenever the system is initialized, the reset switch is pressed, or BASIC operation is terminated by execution of the SYSTEM command.

Numeric keys

There are 19 keys in the numeric key pad, including numeric keys, special symbol keys, and a RETURN key.

Cursor control keys

The cursor control key group consists of four keys for moving the cursor.

System keys

The system control key group consists of three system keys.

(1) Input using the item keys

Since the functions of item keys are defined by the user, the faces of the keys are not marked. Instead, overlay sheets are provided to allow the user to mark the keys as appropriate. Of the two overlay sheets provided, one is preprinted with the key definitions which are effective following system initialization. This sheet is placed over the top of the item keyboard. The user can write his own definitions on the other overlay sheet.
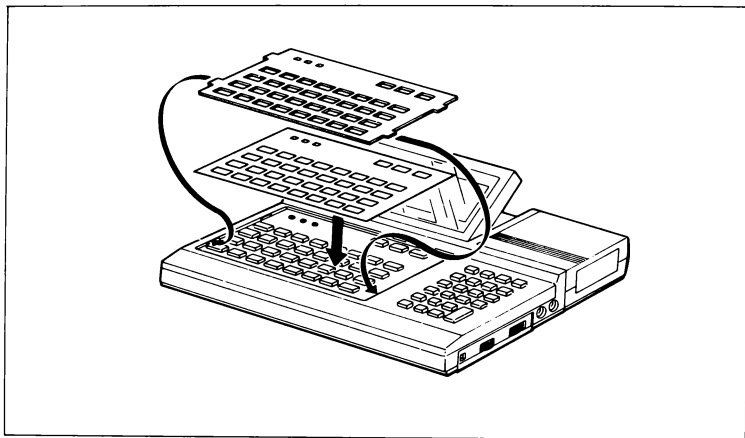
The item key group alternates between the normal mode and the shift mode when the SHIFT key is pressed. When the item keys are in the shift mode, the LED at the upper left corner of the keyboard lights.

Normal mode

Keys which are effective in the normal mode (the mode in which the SHIFT LED is not lit) are as shown below.
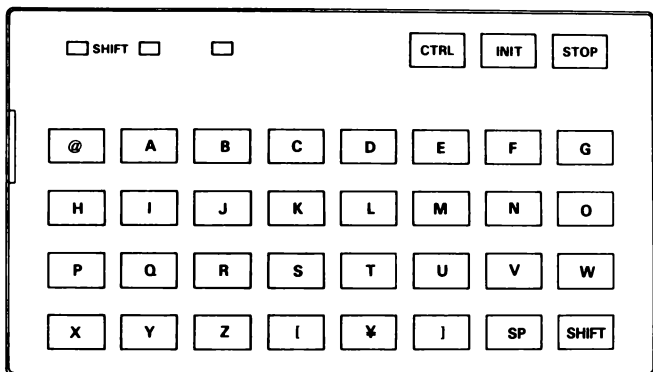
Shift mode

Keys which are effective in the shift mode (the mode in which the SHIFT LED is lit) are as shown below.
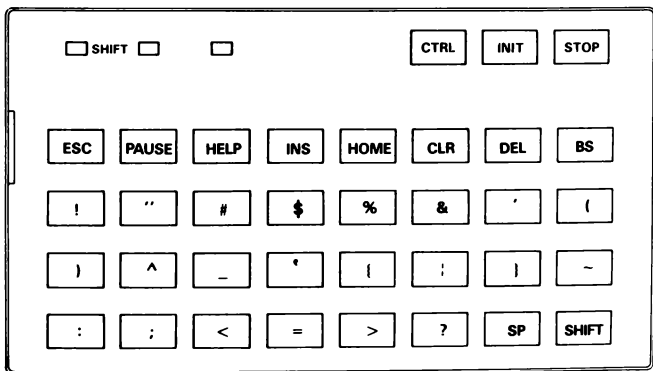
Use of the special keys is as shown below.

`ESC`	Switches from the menu screen to the CCP screen.
`PAUSE`	Momentarily stops execution of CP/M commands or BASIC programs. Execution resumes when any key other than the `SHIFT`, `INIT`, or `STOP` keys is pressed.
`HELP`	Does nothing. Can be used for special purposes in user-written programs.
`INS`	See the explanation of the `SCRN INS` key in 2.3.3, "Using the editing keys."
`HOME`	See the explanation of the `SHIFT` + `HOME BS` keys in 2.3.3, "Using the editing keys."
`CLR`	See the explanation of the `SHIFT` + `CLR DEL` keys in 2.3.3, "Using the editing keys."
`DEL`	See the explanation of the `CLR DEL` key in 2.3.3, "Using the editing keys."
`BS`	See the explanation of the `HOME BS` key in 2.3.3, "Using the editing keys."

(2) Input using the numeric keys

The numeric keys are those whose markings are as shown below.
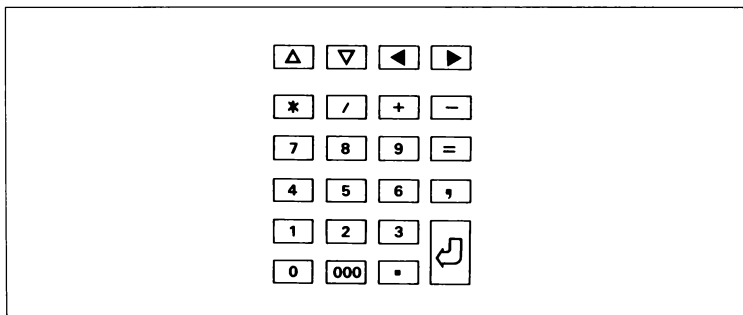
Characters and symbols which can be input using these keys are as follows.

Numerals (0 to 9 and 000)
Alphanumeric symbols (* / + - = , .)
RETURN code

Cursor control keys

The cursor control keys are those keys which are marked as shown below.

$$\boxed{\triangle} \quad \boxed{\triangledown} \quad \boxed{\blacktriangleleft} \quad \boxed{\blacktriangleright}$$

See 2.3.3, "Using the editing keys" for procedures for using the cursor control keys.

(4) Input using the system keys

The system keys are the three keys in the figure below which are marked $\boxed{\text{CTRL}}$, $\boxed{\text{INIT}}$, and $\boxed{\text{STOP}}$.
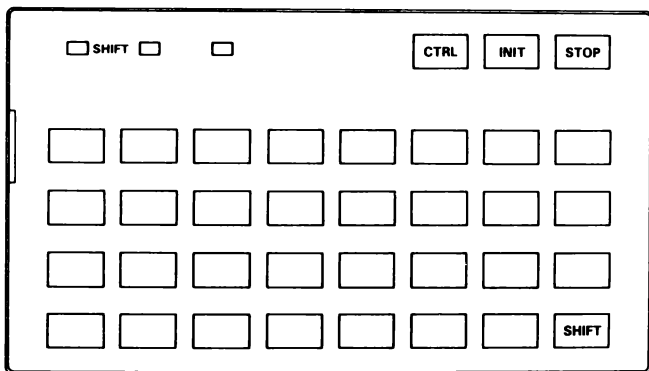
The system keys have special functions, and can only be used as described below.

1. System initialization

System initialization is performed when the reset switch is pressed while holding the $\boxed{\text{INIT}}$ and $\boxed{\text{STOP}}$ keys.

2. $\boxed{\text{STOP}}$

Pressing the $\boxed{\text{STOP}}$ key ends execution of CP/M commands or BASIC programs and returns the system to the command input mode.

3. $\boxed{\text{CTRL}}$ + $\boxed{\text{STOP}}$

Pressing the $\boxed{\text{STOP}}$ key together with the $\boxed{\text{CTRL}}$ key forcibly terminates program execution and any input/output operation which is currently in progress and returns the system to the command input mode.

NOTE:

The system $\boxed{\text{CTRL}}$ key is not the same as the $\boxed{\text{CTRL}}$ on the standard keyboard, and cannot be used in combination with other keys.

Notes concerning item keyboard installation

The item key parameters are as follows following system initialization.
- *The key repeat function is turned off.*
- *The power goes off in the continue mode when the power switch is turned off.*
- *The System Display cannot be displayed.*
- *The screen contents cannot be dumped to the printer by pressing $\boxed{\text{CTRL}}$ + $\boxed{\text{PF5}}$.*

2.3.3 Using the editing keys

The cursor control keys and the [INS], [DEL], and [BS] keys are used for editing commands and messages which have been input from the keyboard and for controlling the screen.

As is indicated in the table below, certain editing keys are used in combination with the [SHIFT] and [CTRL] keys. Further, the functions of the editing keys vary according to the mode of system operation.

Editing key / Screen	[↑]	[↓]	[←]	[→]	SHIFT + [↑]	SHIFT + [↓]	SHIFT + [←]	SHIFT + [→]
Menu	See 2.4.2.							
CCP					Moves the window up one line.	Moves the window down one line.	When the virtual screen is 80 characters wide, moves the window 20 characters to the left.	When the virtual screen is 80 characters wide, moves the window 20 characters to the right.
BASIC	Moves the cursor up one line.	Moves the cursor down one line.	Moves the cursor one character to the left.	Moves the cursor one character to the right.	Same as above.	Same as above.	Same as above.	Same as above.
System Display			Same as above.	Same as above.				

NOTE:
When the item keyboard is installed, the cursor control keys cannot be used with the [SHIFT] key except when the menu screen is displayed.

Editing key / Screen	SCRN INS	CLR DEL	HOME BS	SHIFT + SCRN INS	SHIFT + CLR DEL	SHIFT + HOME BS	CTRL + ↑	CTRL + ↓
Menu			Deletes the character to the left of the cursor.				See 2.4.2.	
CCP	Redisplays the contents of the command buffer.	Deletes one character from the command buffer.	Same as above.	Switches scrolling between the tracking mode and the non-tracking mode.			Moves the window up 8 lines in the virtual screen.	Moves the window down 8 lines in the virtual screen.
BASIC	Switches key input to the insert mode.	Deletes the character at the cursor position.	Same as above.	Same as above.	Clears the screen.	Moves the cursor to the beginning of the virtual screen.	Same as above.	Same as above.
System Display		Inputs a delete character △.	Same as above.					

Editing key / Screen	CTRL + →	CTRL + ←	CTRL + SCRN INS
Menu			
CCP	When the virtual screen is 80 characters wide, moves the window to its right side.	When the virtual screen is 80 characters wide, moves the window to its left side.	Moves the window screen to the position of the cursor.
BASIC	Same as above.	Same as above.	Same as above.
System Display			

NOTES:

1. See 2.6, "Virtual Screen and Window" concerning the CCP screen; for the BASIC screen, see 1.6, "Screen Editor" in the BASIC Reference Manual.

2. The CTRL key cannot be used when the item keyboard is installed.

2.4 Screens

After reading the preceding sections, you have probably noticed that PX-4's operation varies according to what type of screen is being displayed at a given time. For example, a command which is executed properly when input from the keyboard while one screen is displayed may result in an error if input in another screen. Further, the assignments of the function keys may change.

The system states in which operation differs are referred to as the system's operating modes. Different screens are displayed for each operating mode.

PX-4 has three main screens as follows.

> **MENU screen**
> **CCP screen**
> **System Display**

The functions of the various screens are briefly explained below.

MENU screen
The MENU screen displays a list of CP/M application programs which are currently recorded on disks. When a program is selected from the menu list, operation is automatically switched to the CP/M mode, and the program is loaded and executed. You can select whether the menu is displayed or not displayed.

CCP screen
This screen is displayed when the system is operating in the CP/M mode (the mode in which CP/M commands and application programs are executed). In the CP/M mode, either the CCP screen (the screen used to input CP/M commands) or an application program screen is displayed.

System Display (not displayed when the item keyboard is installed)
The System Display is used to turn the MENU screen display function on or off, and to set a variety of other system parameters (such as the wake or alarm settings and the auto start/auto power-off functions).

The System Display can be displayed by pressing $\boxed{\text{CTRL}}$ + $\boxed{\text{HELP}}$ in any operating mode. When the System Display is displayed, operation is returned to the previous mode by pressing the $\boxed{\text{ESC}}$ key.

Try turning on the power switch and pressing the [HELP] key together with the [CTRL] key; a screen with the title "* SYSTEM DISPLAY *" appears. Next, press the [ESC] key and notice the previous screen is displayed again.

2.4.1 Switching screens

The three screens described above are related to each other; that is, display can be switched from one screen to another as shown in the figure below.
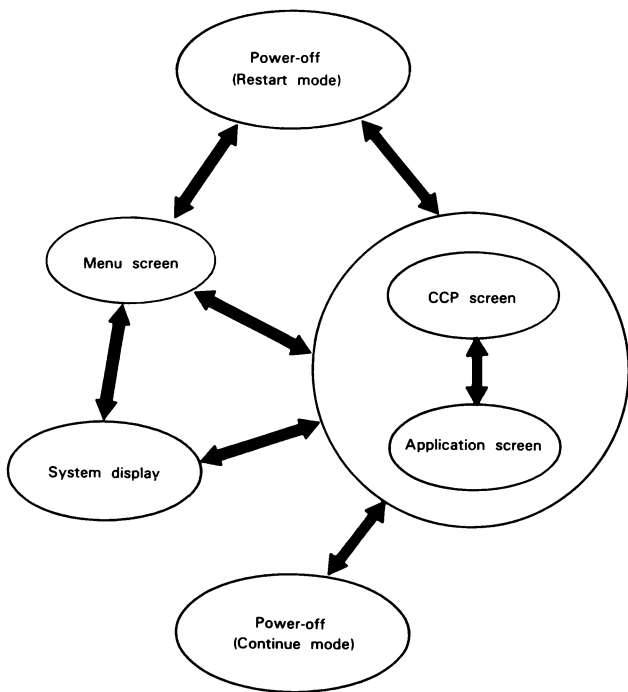
Principal operations for each of the display screens is described below.

MENU screen

Power switch .... When set to OFF, the power is unconditionally turned off in the restart mode.

[ESC] key .... Switches display to the CCP screen.

Program selection .... When a program is selected, the system switches momentarily to the CCP screen for program loading, then the application program is executed.

CCP screen

Power switch .... When set to OFF, the power is turned off in the restart mode; if set to OFF while pressing the [CTRL] key, the power is turned off in the continue mode.

NOTE:
See the explanation of the CP/M operation and the CCP screen in 1.3.1, "Operating system."

System Display

Power switch .... When set to OFF, turns off the power in the restart mode.

[ESC] key .... Returns display to the screen shown before appearance of the System Display.

NOTE:
The System Display cannot be displayed when the item keyboard is installed.

When the item keyboard is installed, the power always goes off in the continue mode when the power switch is set to OFF, regardless of whether the [CTRL] key is pressed.

2.4.2 MENU screen

The MENU screen displays a list of specified program files (CP/M commands and application programs). Program files can be selected from the list with the cursor control keys, then loaded and executed by pressing the RETURN key.

```
##.#k CP/M    05/05 (SAT) 12:08:07  1/6*
B:BASIC
B:BASIC       COM        D:SUBMIT    COM
D:ED          COM        D:STAT      COM
D:ASM         COM        D:LOAD      COM
D:DDT         COM        D:DUMP      COM
D:XSUB        COM        D:Z         COM
D:M           COM        D:L         COM
```

The MENU screen consists of three parts as follows.

1. Header

```
##.#k CP/M    05/05 (SAT) 12:08:19  1/6*
```

The MENU screen header consists of the date and time, the CP/M comment (CP/M size, # # . #), and the current/maximum number of menu pages (1/6 in the example above). An asterisk is displayed to the right of the menu page numbers if there are more than 73 files.

2. Command line

```
B:BASIC.
```

When the program file which is currently selected is executable by itself, its drive name and file name are displayed on the command line (for example, B:BASIC); directly executable files are referred to as COM files because they are identified with the file name extension COM.

If the program file selected is not executable by itself (for example, if it is a BASIC program file), the drive name and file name of the required COM file (e.g., B:BASIC) are displayed on the command line, followed by the drive name, file name, and file name extension of the selected program file. An example of this is shown below, when program file "E:KEY.BAS" is selected. Since this is a BASIC program file, it is displayed on the command line after "B:BASIC".

When the file selected is a COM file, its file name extension is not displayed on the command line.

```
  ##.#k CP/M   05/05 (SAT) 12:38:31   5/6*
B:BASIC       E:KEY.BAS
  E:Z          COM      E:COMP1       COM
  E:KEY        BAS      E:COMP2       COM
  E:FCB        COM      E:DISKCOPY    COM
  E:DDT        COM      E:W           COM
  E:ASM        COM      E:LOAD        COM
  E:SS         COM      E:C2          BAS
```

When a COM file is selected, a cursor (__) is displayed 12 character positions from the left side of the screen; if parameters are to specified when the program file is executed, they can be typed in from the keyboard starting at this position. When typing characters into the command line, mistakes can be corrected by pressing the [BS] key to move the cursor back, then retyping. The command line will hold a maximum of 40 characters.

After command line input has been completed, press the [RETURN] key. This passes the contents of the command line to the CCP, which executes the command.

If the command line will not hold all necessary parameters, press the [ESC] key and type in the command from the CCP screen.

3. Program file list

The program file list is the part of the screen which is shown below.

```
┌─────────────────────────────────────────────────┐
│  B:BASIC      COM      D:SUBMIT    COM           │
│  D:ED         COM      D:STAT      COM           │
│  D:ASM        COM      D:LOAD      COM           │
│  D:DDT        COM      D:DUMP      COM           │
│  D:XSUB       COM      D:Z         COM           │
│  D:M          COM      D:L         COM           │
└─────────────────────────────────────────────────┘
```

Files satisfying the following conditions are displayed in the program file list.

- Files are in a drive which has been specified in the System Display.
- File name extensions are those which have been specified in the System Display. (Up to four file name extensions can be specified in the System Display.)

The program file list may consists of up to six pages, each of which displays the names of up to 12 files. Therefore, a maximum 72 file names can be displayed in the file list. If the number of files whose names should be displayed in the list is greater than 72, an asterisk is displayed at the right side of the header.

Files are selected from the list by using the cursor control keys to move the block cursor (the part of the display in which black and white are reversed) to the desired file name.

Keys which are used for screen control during MENU display are as follows.

Key	Function
↑	Moves the block cursor to the program file name above its current position. The block cursor does not move if it is already at the bottom line of the list.
↓	Moves the block cursor to the program file name below its current position. The block cursor does not move if it is already at the bottom line of the list.
→	Moves the block cursor to the file name to the right of its current position. If the block cursor is already at the right side of the screen, it moves to the first file name on the next line. If it is at the right side of the bottom line, it moves to the first file name on the first line of the list.
←	Moves the block cursor to the file name to the left of its current position. If the block cursor is already at the left side of the screen, it moves to the first file name on the previous line. If it is at the left side of the top line in the list, it moves to the file name on the right side of the bottom line.
SHIFT + ↑	Switches display to the preceding MENU page and positions the block cursor to the first file name in that page. Does nothing if the first page is already being displayed.
SHIFT + ↓	Advances display to the next MENU page and positions the block cursor to the first file name in that page. Does nothing if the last page is already being displayed.
CTRL + ↑	Switches display to the first MENU page and positions the block cursor to the first file name in that page. Does nothing if the first page is already being displayed.

Any parameters on the command line are cleared when any of the above keys are pressed.

NOTE:
CTRL + ↑ *cannot be used when the item keyboard is installed. To use the cursor control keys with the* SHIFT *key, verify that the SHIFT LED is lit, then press the appropriate cursor control key.*

2.4.3 CCP screen

The CCP screen is the first screen which appears in the CP/M mode. This screen is the actual point of origin for all PX-4 operation. All file maintenance and program development is done from this screen, and it is used for execution of all application programs (such as BASIC, CP/M commands, and user programs). This screen always appears immediately after CP/M operation is started, and programs can be executed by inputting commands from this screen. (Although the MENU screen is displayed upon start-up if the MENU display function is on, the system returns to the CCP screen momentarily after program selection in order to execute the program.)

```
A>
```

There are two types of CP/M commands. One of these consists of routines which are built into the CCP (the control key commands and built-in commands). The other (transient commands) consists of program files which are stored in ROM capsules or on floppy disks, and which are executed by typing the drive name and file name from the keyboard and pressing the RETURN key. The file name extension ".COM" is used with all transient commands. Therefore, you can prepare your own transient CP/M commands by writing machine language programs and storing them in the RAM disk under a file name whose extension is .COM.

The flow of program execution under CP/M is shown below.
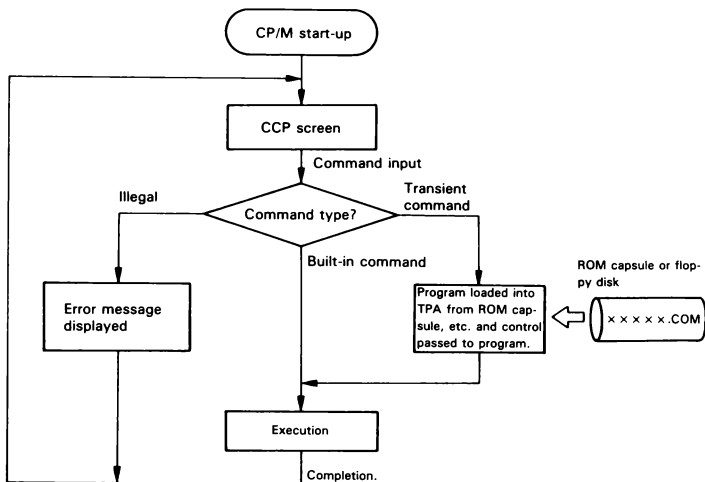
In the CCP screen shown below, the letter "A" indicates a drive name. The drive whose name is displayed on the CCP screen is referred to as the logged-in drive. When the logged-in drive is drive A, the CCP will attempt to load transient program files from drive A when commands are input unless another drive name is specifically specified.

By way of example, try entering the transient command shown below from the CCP screen (the command can be entered in either uppercase or lowercase letters).

```
A>BASIC
```

Since the logged-in drive is drive A, CCP looks for program file BASIC.COM in that drive. However, the file is not in drive A, so an error message is displayed as follows.

```
A>BASIC
BASIC?
A>
```

File BASIC.COM is located in drive B. When the logged-in drive is drive A, the command must be input as follows.

```
A>B:BASIC
```

It is also possible to change the logged-in drive from A to B before inputting the BASIC command. This is done as follows.

```
A>B:
B>BASIC
```

2.4.4 System display

The System Display displays a variety of system parameters, such as the date, time, and sizes of the RAM disk and user BIOS areas. It is also used to set parameters such as the wake/alarm time, auto-start string or alarm message, and MENU display function (on or off). When the optional microcassette drive is installed, it can be manually operated from the System Display.

The System Display screen can be displayed by pressing the $\boxed{\text{HELP}}$ key together with the $\boxed{\text{CTRL}}$ key. However, it cannot be displayed during system initialization or when the item keyboard is installed.

The appearance of the System Display screen is as shown below.

```
* SYSTEM DISPLAY *  05/05 (SAT) 14:42:23
<RAM   DISK> 026    KB   <ALRM> OFF
<USER  BIOS> 000×256 B   <AUTO> OFF
<MENU DRIVE> ABC         <MENU> ON

-Select or ESC to exit.  1=RAM cartridge
2=alarm   3=auto start    4=menu
```

When the optional microcassette drive is installed, the appearance is as follows.

```
* SYSTEM DISPLAY *  05/05 (SAT) 00:06:13
<RAM   DISK> 026    KB   <ALRM> OFF
<USER  BIOS> 000×256 B   <AUTO> OFF
<MENU DRIVE> CBA         <MENU> ON
<MCT  COUNT> 00191
-Select or ESC to exit.  1=RAM cartridge
2=alarm   3=auto start    4=menu    5=MCT
 <<-/      <-/mou  ▓/dint  ->>/era  000/
```

Items included in the System Display are as follows.

Top line .... Title, and date and time
< RAM DISK > .... Indicates the amount of memory which is current-
ly allocated to the RAM disk.
< USER BIOS > .... Indicates the amount of memory which is current-
ly allocated as the user BIOS area.
< MENU DRIVE > .... Indicates drives whose files are displayed in the
menu screen.
< ALRM > .... Indicates whether the alarm function is currently
turned on or off. (See 2.5.1, Alarm.)
< AUTO >.................... Indicates whether the auto-start function is current-
ly turned on or off.
< MENU > .... Indicates whether the menu display function is cur-
rently turned on or off.
< MCT COUNT > .... Displayed only when the optional microcassette
drive is installed. Indicated the current value of the
tape counter.

1 = RAM cartridge .... Effective only when an optional RAM cartridge is
installed; formats the RAM cartridge.
2 = alarm....................... Used to set the alarm or wake function.
3 = auto start .... Used to set the auto-start function.
4 = menu....................... Used to turn the menu display function on or off.
5 = MCT .... Displayed only when the optional microcassette
drive is installed. Used to make a variety of
microcassette settings.

The bottom line of the screen is related to manual operation of the microcas-
sette drive. For details, see section 2.8, "Microcassette Handling."

2.4.5 MENU screen display specification

This section describes procedures for turning on or off the MENU display function from the System Display.

(1) Bring the System Display to the screen by pressing $\boxed{\text{CTRL}}$ + $\boxed{\text{HELP}}$, then press the $\boxed{4}$ key. The screen then changes as shown below.

```
┌─────────────────────────────────────────────────────┐
│ * SYSTEM DISPLAY *   05/05 (SAT) 16:32:59            │
│ <RAM   DISK> 026      KB   <ALRM> OFF                │
│ <USER  BIOS> 000×256 B    <AUTO> OFF                │
│ <MENU DRIVE> CBA          <MENU> ON                 │
│                                                      │
│ -Select or ESC to return.                           │
│  <MENU> 1=off    2=on    3=drive                     │
│         4=ext1   5=ext2  6=ext3   7=ext4             │
└─────────────────────────────────────────────────────┘
```

(2) To turn off the MENU display function, press the $\boxed{1}$ key (1 = off); to turn it on, press the $\boxed{2}$ key (2 = on). If you select $\boxed{1}$, the screen changes as shown below; if you select $\boxed{2}$, go on to the next step (the screen does not change).

```
┌─────────────────────────────────────────────────────┐
│ * SYSTEM DISPLAY *   05/05 (SAT) 16:39:51            │
│ <RAM   DISK> 026      KB   <ALRM> OFF                │
│ <USER  BIOS> 000×256 B    <AUTO> OFF                │
│ <MENU DRIVE> CBA          <MENU> OFF                │
│                                                      │
│ -Select or ESC to exit.   1=RAM cartridge           │
│ 2=alarm   3=auto start    4=menu                     │
└─────────────────────────────────────────────────────┘
```

(3) After the MENU display function has been turned on by specifying $\boxed{2}$, the screen remains as shown in paragraph (1) above. Now, specify what files are to be displayed in the menu screen. Start by pressing the $\boxed{3}$ key to select the drives whose files are to be displayed. After pressing the $\boxed{3}$ key, the screen appears as shown below.

```
┌─────────────────────────────────────────────────────┐
│ * SYSTEM DISPLAY *   05/05 (SAT) 16:33:16            │
│ <RAM   DISK> 026      KB   <ALRM> OFF                │
│ <USER  BIOS> 000×256 B    <AUTO> OFF                │
│ <MENU DRIVE> CBA          <MENU> ON                 │
│                                                      │
│ -Input drive names, ESC to cancel                   │
│  CBA                                                 │
└─────────────────────────────────────────────────────┘
```

Input the names of up to three drives as letters from A to K (either uppercase or lowercase letters may be used). In the example above, drives C:, B:, and A: are specified. Do not include commas, spaces, or other delimiting punctuation between the drive names. After typing in the drive names, press the RETURN key.

(4) The next step is to specify the file name extensions of files which are to be displayed in the MENU screen. This is done from the screen shown in paragraph (1) above. Up to four extensions can be specified; begin specification of each extension by pressing the indicated key (i.e., 4 = ext1, 5 = ext2, 6 = ext3, or 7 = ext4).

For example, to specify the first extension, press the 4 key (for "4 = ext1"). The screen then changes as shown below.

```
* SYSTEM DISPLAY *   05/05 (SAT) 16:33:32
<RAM   DISK> 026     KB  <ALRM> OFF
<USER  BIOS> 000×256 B   <AUTO> OFF
<MENU DRIVE> CBA         <MENU> ON

-Input extension name 1, ESC to cancel
 COM
```

The extension "COM" shown in the screen above is the extension which is automatically set as extension 1 upon system initialization. Another extension can be entered at this point by typing in the appropriate characters and pressing the RETURN key. (Alternatively, display can be returned to the screen shown in paragraph (1) without changing the extension by pressing the ESC key.)

Press the RETURN key, then check extension 2 by pressing the 5 key. The screen will appear as follows.

```
* SYSTEM DISPLAY *   05/05 (SAT) 16:34:27
<RAM   DISK> 026     KB  <ALRM> OFF
<USER  BIOS> 000×256 B   <AUTO> OFF
<MENU DRIVE> CBA         <MENU> ON

-Input extension name 2, ESC to cancel
 BAS B:BASIC
```

The extension "BAS B:BASIC" is the extension which is automatically set during system initialization. The letters "BAS" indicate that files whose extensions are BAS are to be included in the MENU. "B:BASIC" is not part of the extension, but is included to indicate that the letters "B:BASIC" are to be included on the MENU command line whenever a file whose extension is BAS is selected in the MENU screen. This is illustrated in the figure below.

```
 ##.#k CP/M    05/05 (SAT) 16:37:40   1/6
B:BASIC      A:TEST.BAS
  B:BASIC      COM        A:TEST        BAS
  D:SUBMIT     COM        D:ED          COM
  D:STAT       COM        D:ASM         COM
  D:LOAD       COM        D:DDT         COM
  D:DUMP       COM        D:XSUB        COM
  D:Z          COM        D:M           COM
```

The reason for this is that BASIC program files cannot be executed by themselves directly from the MENU, but only while the COM file BASIC is running. When the command line includes both B:BASIC and the name of a BASIC program file, BASIC is automatically started before loading and executing the BASIC program file.

If BAS is specified by itself as a file name extension (if "B:BASIC" is omitted), "B:BASIC" is not included on the command line when a BAS file is selected in the MENU. This is shown in the screens below.

```
 ##.#k CP/M    05/05 (SAT) 17:54:37   1/6
              A:TEST.BAS
  B:BASIC      COM        A:TEST        BAS
  D:SUBMIT     COM        D:ED          COM
  D:STAT       COM        D:ASM         COM
  D:LOAD       COM        D:DDT         COM
  D:DUMP       COM        D:XSUB        COM
  D:Z          COM        D:M           COM
```

When BAS is specified by itself as a file name extension, the MENU screen appears as follows when a BAS program file is selected. An error will result if the RETURN key is pressed while the screen is as shown above.

Procedures for specifying extensions 3 and 4 are the same as those described above for extensions 1 and 2. After settings have been made in this manner, the MENU screen is displayed when System Display is ended and whenever the power is turned on.

The figure below summarizes the manner in which screens are switched during System Display.
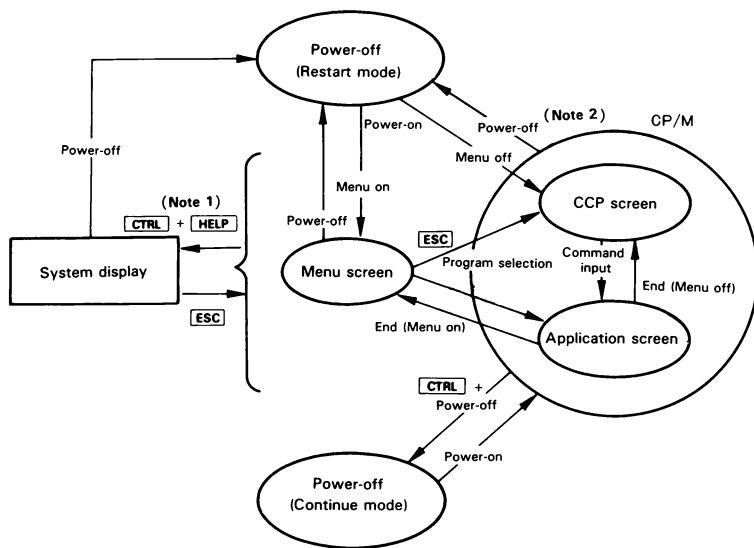
NOTES:
1. *When the item keyboard is installed, the power goes off in the continue mode whenever the power switch is turned off.*
2. *The System Display cannot be displayed while the item keyboard is installed.*

2.5 System Operations

PX-4 is equipped with several convenient functions which are referred to as system operations. This section describes these system operations and procedures for using them. The system operations are as follows.

1. Alarm function ...... Sounds an alarm and displays an alarm screen when a preset time is reached.
2. Wake function .... Turns the computer on and performs a specific job when a preset time is reached.
3. Auto start .... Automatically executes a specific job whenever the computer is turned on.
4. Auto power-off ...... Automatically turns off the power when a certain amount of time has passed without anything being input from the keyboard.
5. Screen dump.......... Outputs the contents of the display screen to a printer.

Of these system operations, the alarm, wake, and auto start functions are set from the System Display.

2.5.1 Alarm

The alarm function sounds an alarm at a present time and displays a screen such as the one shown below.

```
<ALARM TIME>    05/05   18:20

  " WE HAVE DINNER                    "

        Press ESC key
```

Setting the alarm time

(1) The alarm time can be set from the System Display by pressing the 2 key to select 2 = alarm when the screen appears as shown below.

```
* SYSTEM DISPLAY *  05/05 (SAT) 17:08:30
<RAM   DISK> 026    KB   <ALRM> OFF
<USER  BIOS> 000×256 B   <AUTO> OFF
<MENU DRIVE> CBA         <MENU> OFF

-Select or ESC to return.
 <ALARM>  1=off  2=alarm  3=wake   4=MSG
```

(2) When the 2 key is pressed, the screen changes as follows.

```
* SYSTEM DISPLAY *  05/05 (SAT) 18:23:56
<RAM   DISK> 026    KB   <ALRM> OFF
<USER  BIOS> 000×256 B   <AUTO> OFF
<MENU DRIVE> CBADE       <MENU> OFF

-Set alarm time, ESC to cancel
 MMDDhhmm
```

To set the alarm time, input two digits each for the month, day, hour, and minute (in that order). Input the time using the 24-hour system; e.g., input 2:00 P.M. as 1400.

For example, to input May 5, 6:30 P.M., input 05051830. If any incorrect keys are pressed, make corrections by pressing the `BS` key; this deletes the last character entered and moves the cursor one space to the left. To move the cursor to the left without deleting the last character entered, press the `←` key. After typing in the date and time, check to make sure that they are correct, then press the `RETURN` key.

If you want to return to quit alarm specification without specifying an alarm time, press the `ESC` key.

```
* SYSTEM DISPLAY *   05/05 (SAT) 18:24:10
<RAM   DISK> 026      KB   <ALRM> OFF
<USER  BIOS> 000×256 B    <AUTO> OFF
<MENU DRIVE> CBADE         <MENU> OFF

-Set alarm time, ESC to cancel
 MMDDhhmm  05051830
```

NOTE:
Any wake time which has been set is cancelled when an alarm time is set.

Setting the alarm message
(1) After selecting 2 = alarm from the initial System Display screen, press the `4` key to select 4 = MSG. The screen then changes as shown below.

```
* SYSTEM DISPLAY *   05/05 (SAT) 20:03:37
<RAM   DISK> 026      KB   <ALRM> ON
<USER  BIOS> 000×256 B    <AUTO> OFF
<MENU DRIVE> CBADE         <MENU> OFF

-Input message/string, ESC to cancel
```

(2) Type in the message which is to be displayed in the alarm screen when the alarm time is reached. The message may include up to 32 characters. Use the `BS`, `←`, and `→` keys to correct any mistakes. After verifying that the message has been typed correctly, set it by pressing the `RETURN` key.

```
* SYSTEM DISPLAY *  05/05 (SAT) 17:09:27
<RAM   DISK> 026      KB   <ALRM> ON
<USER  BIOS> 000x256 B    <AUTO> OFF
<MENU DRIVE> CBA          <MENU> OFF

-Input message/string, ESC to cancel
 TEA TIME
```

Alarm operation

When the preset alarm time is reached, operation is as described below. Here we will assume that the alarm has been set for the time indicated above and that the current time is 18:29 on May 5; thus, the alarm time will be reached after waiting for one minute. After reaching the alarm time, the alarm sounds and the following screen appears.

```
<ALARM TIME>     05/05    18:30

   " TEA TIME                          "

          Press ESC key
```

Ending alarm screen display

Alarm screen display is ended under any of the following conditions.

- When the `ESC` key is pressed. This returns the computer to the state it was in before the alarm time was reached.
- After 50 seconds have passed. This returns the computer to the state it was in before the alarm time was reached.
- When the power switch is turned off (if it is already off, by turning it on momentarily, then back off again). This causes the power to go off in the restart mode.

Cancelling the alarm time and message

To cancel the alarm setting, enter the System Display, select "2 = alarm", then select "1 = off". This cancels both the alarm time and alarm message and changes the "<ALRM>" status from ON to OFF.

2.5.2 Wake

The wake function sounds an alarm when a preset time is reached, then turns PX-4 on. If the wake time is reached while PX-4's power switch is in the OFF position, operation is the same as when the power switch is turned on. If the wake time is reached while the power is already on, the alarm is sounded and a screen such as the following is displayed.

```
<WAKE TIME>      05/05    18:21

 " WAKE STRING                            "

          Press ESC key
```

Setting the wake time

(1) Press CTRL + HELP to display the System Display, then select "2 = alarm". The screen then changes as shown below.

```
* SYSTEM DISPLAY *  05/05 (SAT) 20:34:25
<RAM   DISK> 026     KB  <ALRM> OFF
<USER  BIOS> 000×256 B   <AUTO> OFF
<MENU DRIVE> CBADE        <MENU> OFF

-Select or ESC to return.
 <ALARM>  1=off  2=alarm  3=wake   4=MSG
```

(2) Select "3 = wake". The screen changes again as follows.

```
* SYSTEM DISPLAY *  05/05 (SAT) 20:39:08
<RAM   DISK> 026     KB  <ALRM> OFF
<USER  BIOS> 000×256 B   <AUTO> OFF
<MENU DRIVE> CBADE        <MENU> OFF

-Set wake time, ESC to cancel
 MMDDhhmm
```

(3) To set the wake time, input two digits each for the month, day, hour, and minute (in that order). Input the time using the 24-hour system; e.g., input 2:00 P.M. as 1400.

For example, to input May 5, 9:00 P.M., input 05052100.

After typing in the date and time, check to make sure that they are correct. Use the ← and → keys to correct any mistakes, then press the RETURN key to set the time.

If you want to quit wake specification without specifying an wake time, press the ESC key.

```
/ * SYSTEM DISPLAY *   05/05 (SAT) 20:39:30 \
| <RAM   DISK> 026      KB  <ALRM> OFF        |
| <USER  BIOS> 000x256 B   <AUTO> OFF         |
| <MENU DRIVE> CBADE        <MENU> OFF        |
|                                             |
| -Set wake time, ESC to cancel               |
|  MMDDhhmm  05052100                         |
\                                             /
```

NOTE:
Any alarm time which has been set is cancelled when an wake time is set.

Setting the wake string
The wake string consists of characters which are automatically input (just as if they were typed in from the keyboard) when PX-4's power is turned on by the wake function. When the MENU display function is turned on, the wake string is automatically inserted into the command line starting at the position of the cursor. If the MENU display function is turned off, it is automatically input into the CCP command line.

Procedures for setting a wake string are explained with examples below.

(1) When the MENU display function is turned on
If a return code (^M or ^m) is set for the wake string as shown below, the program which is indicated on the command line of the MENU screen will be automatically executed when the power is turned on by the wake function. In other words, operation is the same as if the power were turned on and the RETURN key pressed.

```
/ * SYSTEM DISPLAY *   05/05 (SAT) 20:39:50 \
| <RAM   DISK> 026      KB  <ALRM> ON(W)      |
| <USER  BIOS> 000x256 B   <AUTO> OFF         |
| <MENU DRIVE> CBADE        <MENU> OFF        |
|                                             |
| -Input message/string, ESC to cancel        |
|  ^M                                         |
\                                             /
```

When the MENU screen is as shown in the following figure, BASIC is automatically executed.

```
##.#k CP/M     05/05 (SAT) 21:00:00   1/6*
B:BASIC
B:BASIC        COM        D:SUBMIT   COM
D:ED           COM        D:STAT     COM
D:ASM          COM        D:LOAD     COM
D:DDT          COM        D:DUMP     COM
D:XSUB         COM        D:Z        COM
D:M            COM        D:L        COM
```

It is also possible to specify BASIC parameters (such as a program file name) or start-up options (such as the maximum number of files) in the wake string together with the return code. The wake string may consist of a maximum of 32 characters (including control codes).

(2) When the MENU display function is turned off
When the wake time is reached while the MENU display function is turned off, the wake string is input directly to the command line of the CCP screen. An example is shown below.

```
* SYSTEM DISPLAY *   05/05 (SAT) 17:08:00
<RAM   DISK> 026        KB      <ALRM> ON(W)
<USER  BIOS> 000×256 B          <AUTO> OFF
<MENU DRIVE> CBA                <MENU> OFF

-Input auto start string, ESC to cancel
 B:BASIC^M
```

Cancelling the wake time and wake string
To cancell the wake setting, enter the System Display, select "3 = wake", then select "1 = off". This cancels both the wake time and wake string and changes the "<ALRM>" status from ON to OFF.

Ending wake screen display
When the wake time is reached while the power is on, wake screen display ends under any of the following conditions.

• When the [ESC] key is pressed. This returns the computer to the state it was in before the wake time was reached.

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- After 50 seconds have passed. The computer returns to the state it was in before the wake time was reached.
- When the power switch is turned off. This causes the power to go off in the restart mode.

Using wildcard characters (∗) to specify the alarm or wake time

Ordinarily, the alarm or wake time is specified using only numbers. However, it is also possible to specify all or part of the date and time using wildcard characters (i.e., asterisks). When this is done, positions filled with asterisks are always assumed to match the corresponding position in the current time. For example, wake operation will take place at all of the following times if the wake string is specified as 050518∗0.

05051800	05051830
05051810	05051840
05051820	05051850

To see how this works, try setting an alarm time as follows.

Press CTRL + HELP to display the System Display, then select "2 = alarm". Check the time displayed in the top right corner of the screen, type in the date and hour as shown, then type in asterisks for the minute. For example, if the current date/time 18:00, May 5, type in an alarm time as shown below. (Remember to press the RETURN key after typing in the time.)

```
∗ SYSTEM DISPLAY ∗  05/05 (SAT) 18:00:26
<RAM   DISK> 026     KB   <ALRM> OFF
<USER  BIOS> 000×256 B    <AUTO> OFF
<MENU DRIVE> CBADE        <MENU> OFF

-Set alarm time, ESC to cancel
 MMDDhhmm  050518∗∗
```

After setting the alarm time, leave the machine untouched for about 5 minutes and watch what happens. The alarm should sound within one minute, then will sound repeatedly at intervals of one minute. Also, the alarm screen should appear when the alarm sounds. If the ESC key is pressed while the alarm screen is displayed, the System Display will appear again. Otherwise, the System Display reappears automatically after 50 seconds have passed.

Some other examples of alarm time settings using the asterisk are shown below.

05∗∗0800	Causes the alarm function to operate at 8:00 every day in May.
∗∗∗∗1200	Causes the alarm function to operate every day at 12:00 noon.

2.5.3 Auto start function

The auto start function causes a predesignated command to be executed automatically each time the power switch is turned on while PX-4's power is off in the restart mode. However, this function does not operate when the power is off in the continue mode.

Setting the auto start string

The auto start string consists of character data which is automatically passed to the CCP when PX-4's power switch is turned on while the power is off in the restart mode. (If the MENU display function is turned on, the contents of the auto start string are automatically input into the parameter area of the MENU screen command line; otherwise, they are automatically input to the CCP screen.)

(1) Press CTRL + HELP to bring the System Display to the screen.

```
* SYSTEM DISPLAY *   05/05 (SAT) 18:13:19
<RAM   DISK> 026     KB   <ALRM> OFF
<USER  BIOS> 000×256 B    <AUTO> ON
<MENU DRIVE> CBADE        <MENU> OFF

-Select or ESC to exit.   1=RAM cartridge
2=alarm   3=auto start    4=menu
```

Press the 3 key to select "3 = auto start"; the screen changes as shown below.

```
* SYSTEM DISPLAY *   05/05 (SAT) 18:12:51
<RAM   DISK> 026     KB   <ALRM> OFF
<USER  BIOS> 000×256 B    <AUTO> OFF
<MENU DRIVE> CBADE        <MENU> OFF

-Select or ESC to return.
 <AUTO START>   1=off   2=assign
```

(2) Select 2 = assign. Now the screen will appear as follows.

```
* SYSTEM DISPLAY *   05/05 (SAT) 18:14:28
<RAM   DISK> 026     KB   <ALRM> OFF
<USER  BIOS> 000×256 B    <AUTO> OFF
<MENU DRIVE> CBADE        <MENU> OFF

-Input auto start string, ESC to cancel
```

(3) Now type in the command which is to be set as the auto start string. If you want to include a return code at the end of the string, type ^M ("M" can be typed in either uppercase or lowercase). The auto start string may consist of up to 32 characters (including ^M or other control codes). After typing in the string, verify that it is correct, then set it by pressing the RETURN key. An example is shown below.

```
* SYSTEM DISPLAY *   05/05 (SAT) 18:13:08
<RAM   DISK> 026    KB   <ALRM> OFF
<USER  BIOS> 000x256 B   <AUTO> OFF
<MENU DRIVE> CBADE       <MENU> OFF

-Input auto start string, ESC to cancel
 B:BASIC^M
```

After the auto start string has been set, the <AUTO> status changes from OFF to ON.

```
* SYSTEM DISPLAY *   05/05 (SAT) 18:17:43
<RAM   DISK> 026    KB   <ALRM> OFF
<USER  BIOS> 000x256 B   <AUTO> ON
<MENU DRIVE> CBA         <MENU> OFF

-Select or ESC to exit.  1=RAM cartridge
 2=alarm   3=auto start   4=menu
```

Start-up by the auto-start string

When the power switch is turned on while an auto start string is set (or if the power is already on, when the power switch is turned on, off, and then on again), the auto start string is handled in the same manner as if it had been input from the keyboard.

However, this only applies when PX-4 is off in the restart mode; when it is off in the continue mode, the auto start string is not input.

As with the wake string, whether the auto start string is input to the CCP screen or the MENU screen differs according to whether the MENU display function is turned on.

(1) When the MENU display function is turned off

When the MENU display function is turned off, the auto start string is input directly to the command line of the CCP screen. For example, when "B:BASIC^M" is specified as the auto start string, BASIC is started.

```
A>B:BASIC
```

(2) When the MENU display function is turned on

When the MENU display function is turned on, the auto start string is input to the MENU screen command line when the power is turned on. In this case, the auto start string would be used to pass parameters to a program file; an example of this is shown below.

```
* SYSTEM DISPLAY *  05/05 (SAT) 18:28:23
<RAM  DISK> 026     KB  <ALRM> OFF
<USER  BIOS> 000x256 B  <AUTO> OFF
<MENU DRIVE> ABC        <MENU> ON

-Input auto start string, ESC to cancel
/P:3
```

In this example, the auto start string is input to the MENU screen as follows when the name of a COM file is displayed on the MENU screen command line.

```
 ##.#k CP/M   05/05 (SAT) 18:29:02  1/1
B:BASIC     /P:3
███████████████████████████
```

When the file displayed on the MENU screen command line is not a COM file, the auto start string is input to the command line as follows.

```
 ##.#k CP/M   05/05 (SAT) 18:29:32  1/1
B:BASIC    A:TEST.BAS /P:3
███████████████████████  B:BASIC    COM
```

Cancelling the auto start string

To cancel the auto start string, display the auto start string specification screen and select "1 = OFF".

2.5.4 Auto power-off function

The purpose of the auto power-off function is to automatically turn off the power when the computer has been standing by for input from the keyboard for a certain period of time. This helps conserve battery power when the power is left on accidentally or the computer is left unattended for any reason. However, since power is constantly supplied to PX-4's RAM disk and memory, this does not result in the loss of any information. Further, the auto power-off function turns off the power in the continue mode; this means that operation can be resumed at the point of interruption simply by turning the power switch off, then back on again.

Setting the auto power-off time

Immediately after system initialization, the auto power-off function is set to turn off the computer after five minutes have elapsed since the last key was pressed. However, the setting can be changed to turn off the power after from 1 to 255 minutes have elapsed; this is done using the POWER statement of BASIC or the CONFIG command. See the description of the POWER statement in the BASIC Reference Manual for further details.

2.5.5 Screen dump function

The screen dump function outputs the contents of the display screen to a printer. This is done by pressing the [PF5] key together with [CTRL]. Output to the printer can be interrupted by pressing the [STOP] key together with [CTRL] or by turning off the power switch.

When output to the printer is completed without error, PX-4 returns to the state it was in before the screen dump was started.

NOTES:
1. In order to use the screen dump function, a printer must be connected to the RS-232C interface, the serial interface, or the printer interface and the interface specifications must match those of the printer.
2. The screen dump function cannot be used under the following condition.
   • While the system initialization screen is being displayed

If the contents of the display are not output to the printer when [CTRL] + [PF5] is pressed, terminate operation by pressing [CTRL] + [STOP], then make sure that the printer is connected properly and that the DIP switch settings are correct (see section 4.3, ''Printers'').

Method 5 initiates system initialization, followed by a cold start. Accordingly, all previously set system parameters (such as user BIOS size and System Display settings) are cleared. This type of restart is ordinarily used only to restore system operation following execution of a machine language program which contains an error.

```
SYSTEM INITIALIZE
DATE/TIME (MMDDYYhhmmss) 000000000000
```

See section 2.1, "Introduction to Operation" for the system initialization procedures.

Method 6 resets the 7508 sub-CPU. To do this, press the 7508 reset switch inside the ROM capsule compartment. After doing this, initialize the system (method 5).

Ordinarily, system operation can be restored by one of methods 1 to 4. Therefore, methods 5 and 6 should only be used as a last resort when system operation cannot be restored by one of the first four methods.

<Internal RAM disk check>
The contents of the internal RAM disk are checked whenever the reset switch is pressed or the power switch is turned on. If the contents of the RAM disk are accidentally destroyed during program execution, the following message is displayed.

```
RAM DISK FORMAT (Y/N) ?
```

If you want to reformat the RAM disk, press the Y key; otherwise, press the N key.

2.5.6 Restarting the system

If the system becomes inoperative for any reason while using PX-4 (as can happen, for example, if a user-written machine language program contains an error), it will be necessary to restart the system. There are six methods of doing this; the method which is used will vary according to the seriousness of the problem.

1. Press the CTRL and C keys together.
2. Press the STOP key.
3. Press the CTRL and STOP keys together.
4. Press the reset switch.
5. Press and hold the SHIFT and GRPH keys, then press the reset switch.
6. Press the 7508 reset switch (the switch which resets the 7508 sub-CPU).

Each of these methods is briefly described below.

Methods 1 to 3 all produce the same result. That is, a warm start is made and the screen appears as shown below. (If the MENU display function is turned on, the MENU screen is displayed.)

```
A>
```

When the system is restarted using methods 1 to 3, the contents of the RAM disk and user BIOS areas are preserved.

When method 4 is used, the Z-80 main CPU is reset and a cold start is made. The contents of the RAM disk and user BIOS areas are also preserved when this method is used.

2.5.7 Audible signals generated by the system

PX-4's operating system generates a variety of audible signals to inform the user of the system's status. Types of audible signals generated and the conditions to which they correspond are as shown in the table below.

Condition	Signal
Power switch turned on with PX-4 in the restart mode	Short beep(–)
Power switch turn on with PX-4 in the continue mode	Long beep(——)
Alarm or wake time reached while the power is off	Warbling sound
Alarm or wake time reached while the power is on	∧∧∧

Example: When the wake time is reached while the power is off in the restart mode, signals generated are as follows.

∧∧∧ –

2.6 Virtual Screen and Window

The display screen used with PX-4 is a large (40 characters × 8 lines) LCD panel. However, since some applications require even larger display sizes, a kind of display-screen-in-memory called a "virtual screen" is also used.

In other words, the virtual screen uses a special area in memory which is handled in much the same manner as an actual display screen, and which stores data for output to the LCD panel. This special area in memory is referred to as "video RAM" (VRAM). Although you cannot see the entire contents of the virtual screen at one time, you can use the cursor keys to change the part of the virtual screen which appears on the LCD panel at any given moment; this is referred to as "scrolling through the virtual screen." You can scroll up or down and (depending on the width of the virtual screen) left or right.

In other words, you can think of the LCD screen as a window which can be moved around above a large sheet of paper; therefore, the LCD screen is also sometimes referred to as the window.
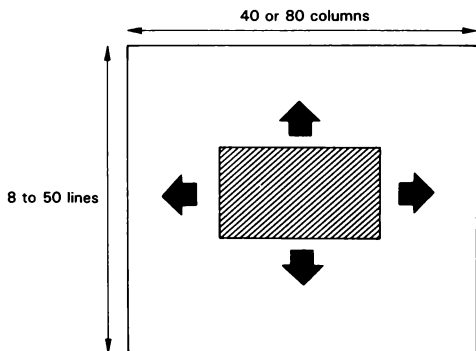
The height and width of the virtual screen can be changed using the WIDTH statement of BASIC. Either 40 or 80 columns can be specified for the width, and the height can be specified as any number of lines in the range from 8 to 50; however, the product of the width × height must not be greater than 2,000. Therefore, maximum virtual screen dimensions for each screen width are as follows.

(1) 80 columns × 25 lines
(2) 40 columns × 50 lines

Further, graphic data can be written into the screen using a coordinate system which addresses individual dots. The graphic screen coordinate system is shown in the figure below.
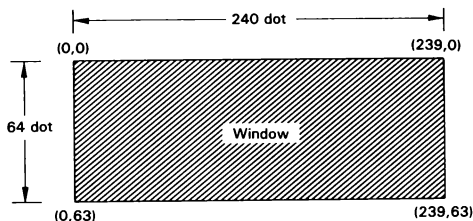
Graphic data can be written into the screen regardless of any characters which happen to displayed or their positions. However, when any graphics which are scrolled outside of the screen window are erased, and will not be redisplayed when the screen window is scrolled back to that position.

Types of Scrolling Used with the Virtual Screen

When the cursor is moved through the virtual screen, the mode of scrolling selected determines whether the window moves along with the cursor.

With one mode, the window tracks (follows) the cursor as it is moved in any direction; with another, the window stays in the same position regardless of where the cursor is moved; and with the third mode, the window tracks horizontal movement of the cursor, but not vertical movement.

(1) The tracking mode

In the tracking mode, the window follows cursor movement in all directions.

(2) Non-tracking mode

In the non-tracking mode, the window stays in the same place regardless of where the cursor is moved. However, if scrolling is switched from the non-tracking mode to the tracking mode while the cursor is located outside of the window, the window immediately moves to the position of the cursor. The window can also be moved to the position of the cursor without switching modes by pressing the $\boxed{\substack{\text{SCRN} \\ \text{INS}}}$ key together with $\boxed{\text{CTRL}}$.

(3) Horizontal tracking mode

In the horizontal tracking mode, the window follows horizontal movement of the cursor, but does not move vertically. This mode can only be used when the virtual screen width is 80 columns.

Scrolling is switched between these three modes by pressing the $\boxed{\substack{\text{SCRN} \\ \text{INS}}}$ key together with $\boxed{\text{SHIFT}}$.

2.7 CP/M Commands

There are three types of CP/M commands as follows.

> Control key commands
> Built-in commands
> Transient commands

2.7.1 Control key commands

Control key commands are commands which are input by pressing various letter or number keys on the standard keyboard together with the `CTRL` (control) key (control key commands cannot be input when the item keyboard is installed). To input any of the control key commands, press and hold the `CTRL` key, then press the applicable letter or number key. The control key commands and their functions are as listed below.

`CTRL` + `C` : Restarts CP/M by initiating a warm start.

`CTRL` + `E` : Forces the cursor to the next line of the screen for continued command line input.

`CTRL` + `H` : Moves the cursor one space to the left in the same manner as the `BS` key.

`CTRL` + `I` : Inputs a tab code (same as the `TAB` key).

`CTRL` + `P` : Turns on or off the printer echo function. When the printer echo function is turned on, data displayed on the LCD screen is output to the printer (or other device assigned to LST:) each time the `RETURN` key is pressed. The printer echo function is turned on by pressing `CTRL` + `P` once, and is turned off when `CTRL` + `P` is pressed a second time. (Make sure the printer is connected properly before using this command.)

`CTRL` + `R` : Redisplays the contents of the current command line.

`CTRL` + `S` : Momentarily stops processing currently being performed (same as the `PAUSE` key). Processing can be resumed by inputting this command again.

`CTRL` + `U` : Cancels the current command line and moves the cursor to the next line on the screen for input of a different command.

`CTRL` + `X` : Erases the current command line and moves the cursor back to the beginning of the line.

`CTRL` + `Z` : Terminates input from the keyboard (used in combination with certain CP/M transient commands).

Specifying file names when using commands

In this manual, points at which file descriptors are specified in CP/M commands are indicated by the following notation.

< filespec >

The < filespec > is composed of three parts as follows.

d:filename.ext

Here, "d:" indicates a drive name, "filename" indicates the name of the file being handled, and ".ext" indicates the file name extension.

d: .... Specify the drive name as a single letter. Drives supported by PX-4 are as follows.

      A: .... RAM disk
      B:.............. ROM capsule 1
      C: .... ROM capsule 2
      D: .... Floppy disk drive
      E:.............. Floppy disk drive
      F:.............. Floppy disk drive
      G: .... Floppy disk drive
      H: .... Microcassette drive
      I: .... RAM cartridge
      J: .... ROM cartridge 1
      K: .... ROM cartridge 2

      If no drive name is specified, the currently logged-on drive is assumed.

filename .... The file name is specified using up to 8 characters. Only alphanumeric characters and symbols can be used in the file name.

.ext .... The file extension ordinarily consists of three letters which indicate the file type. Some examples are shown below.

      .COM .... Indicates an executable program file (transient command).
      .ASM......... Indicates an assembler source program file.

.SYS .... Indicates a CP/M system program file.
.BAS.......... Indicates a BASIC application program file.
.LIB .... Indicates a library file.

Only files with the file name extension ".COM" can be executed as CP/M transient commands.

Special characters used in < filespec >

Two special characters can be used when specifying file names and file name extensions. These are referred to as wildcard characters, and their functions are as follows.

? (question mark): When a question mark is specified in "filename.ext", it is regarded as matching any character in the corresponding position in all files in the drive being accessed.

Example: A:TEST?.BAS
This file descriptor indicates any file in drive A: which has a five-letter file name beginning with "TEST" and whose extension is ".BAS".

* (asterisk): Indicates any group of characters in a file name or extension.

Example: A:TEST*.BAS
This file descriptor indicates any file in drive A: whose file name begins with the letters "TEST" and whose extension is ".BAS".

NOTE:
*Wildcard characters (? and *) cannot be used to specify the drive name. A file descriptor specified using wildcard characters is referred to as a "filematch" or "ambiguous file name".*

An example of use of a filematch is shown below.

Assume that files in drive A: are as shown below.

```
##.#ド CP/M   05/05 (SAT) 00:04:55  1/1
B:BASIC        A:TEST1.BAS
A:TEST1      BAS       A:TEST02      BAS
A:TESTA      BAS       A:TES001      BAS
A:TEST2      BAS       A:TESTTT      BAS
A:TEST3      BAS       A:TEST4       BAS
A:PROG1      BAS       A:PROG2       BAS
A:PROGAA     BAS       A:PROGG       BAS
```

Note the difference in the directory lists which are displayed when
"TEST*.BAS" and "TEST?.BAS" are specified as file descriptors with the
DIR command (the command used to display a directory of files stored in disk
drives).

```
A>DIR A:TEST*.BAS
A:  TEST1      BAS :  TEST02     BAS
A:  TESTA      BAS :  TEST2      BAS
A:  TESTTT     BAS :  TEST3      BAS
A:  TEST4      BAS
A>
A>DIR A:TEST?.BAS
A:  TEST1      BAS :  TESTA      BAS
A:  TEST2      BAS :  TEST3      BAS
A:  TEST4      BAS
A>
```

All files in drive A: will be displayed if the file descriptor is specified as "*.*".

```
A>DIR *.*
A:  TEST1      BAS :  TEST02     BAS
A:  TESTA      BAS :  TES001     BAS
A:  TES002     BAA :  TEST2      BAS
A:  TESTTT     BAS :  TEST3      BAS
A:  TEST4      BAS :  PROG1      BAS
A:  PROG2      BAS :  PROGAA     BAS
A:  PROGG      BAS
A>
```

2.7.2 Built-in commands

Built-in commands are commands which are loaded into memory as part of the CP/M operating system when CP/M is started.
The built-in commands are as follows.

1. DIR (directory) .... Displays a list of all file names in the specified drive which correspond to < filespec >.
2. ERA (erase) .... Erases files corresponding to < filespec > from the specified drive.
3. REN (rename) .... Changes the file name or extension of the specified file.
4. SAVE (save).............. Saves the contents of the specified number of pages of the transient program area as a file. Pages start at address 100H, and each page consists of 256 bytes.
5. TYPE (type).............. Displays the contents of the specified file on the screen.
6. USER (user).............. Used to select a user area in a disk drive.

DIR

DIR drivename:filename.ext

Displays a list of files stored in the specified drive.

The DIR command can be used in three ways as follows.

(1) DIR d:
Displays a list of all files in the drive specified by d:. If d: is omitted, displays a list of all files in the currently logged in drive. If no files are present on the specified drive, displays the message ''NO FILE''.

Example
```
A>DIR
A: TEST      BAS : PROG      COM
A>

A>B:
B>DIR A:
A: TEST      BAS : PROG      COM
B> .

A>DIR
NO FILE
A>
```

(2) DIR d:filename.ext
Displays the name of the specified file in the specified drive.

Example
```
A>DIR A:TEST1.BAS
A: TEST1     BAS
A>DIR TEST2.BAS
A: TEST2     BAS
A>
```

(3) DIR d:filematch

Displays the names of all files in drive d: which correspond to filematch.

```
Example     A>DIR TEST*.BAS
            A: TEST1     BAS : TEST2     BAS
            A>DIR *.BAS
            A: TEST1     BAS : TEST2     BAS
            A: PROG      BAS : PROG1     BAS
            A: PROG2     BAS : SAMP1     BAS
            A: SAMP2     BAS
            A>DIR TEST1.*
            A: TEST1     BAS : TEST1     DAT
            A>DIR SAMP?.BAS
            A: SAMP1     BAS : SAMP2     BAS
            A>
```

ERA

Format   **ERA d:filename.ext**

Function   **Deletes specified files from the specified drive.**

There are two methods of using the ERA command as follows.

(1) ERA d:filename.ext
Deletes the file specified by "filename.ext" from drive specified by "d:".

Example
```
A>DIR
A: TEST1    BAS : TEST2    BAS
A: TEST1    DAT : TEST2    DAT
A: PROG     BAS : PROG1    BAS
A: PROG2    BAS : SAMP1    BAS
A: SAMP2    BAS : SAMPLE   DAT
A: SAMPLE   ASM
A>ERA A:PROG.BAS
A>DIR
A: TEST1    BAS : TEST2    BAS
A: TEST1    DAT : TEST2    DAT
A: PROG1    BAS : PROG2    BAS
A: SAMP1    BAS : SAMP2    BAS
A: SAMPLE   DAT : SAMPLE   ASM
A>
```

In the example above, the DIR command is used to show how the directory changes when a file is deleted by executing the ERA command.

(2) ERA d:filematch

Deletes all files from the specified drive whose file names correspond to "filematch".

Example   Deleting all files from the currently logged-in drive whose file names begin with "TEST" and whose extension is ".DAT".

```
A>DIR
A: TEST1     BAS : TEST2     BAS
A: TEST1     DAT : TEST2     DAT
A: PROG1     BAS : PROG2     BAS
A: SAMP1     BAS : SAMP2     BAS
A: SAMPLE    DAT : SAMPLE    ASM
A>ERA TEST*.DAT
A>DIR
A: TEST1     BAS : TEST2     BAS
A: PROG1     BAS : PROG2     BAS
A: SAMP1     BAS : SAMP2     BAS
A: SAMPLE    DAT : SAMPLE    ASM
A>
```

Example   **ERA *.***

Deletes all files from the logged-in disk. Before files are deleted, a message is displayed to request confirmation that all files are to be deleted. Files are deleted only when the [Y] key is pressed in response to this message.

```
A>DIR
A: TEST1     BAS : TEST2     BAS
A: PROG1     BAS : PROG2     BAS
A: SAMP1     BAS : SAMP2     BAS
A: SAMPLE    DAT : SAMPLE    ASM
A>ERA *.*
ALL (Y/N)?Y
A>DIR
NO FILE
A>
```

REN

Format   **REN d:newfilename.ext = oldfilename.ext**

Function   **Changes the name of a disk file from "oldfilename" to "new-filename".**

The name which is specified for "newfilename.ext" must not belong to any other file in the drive.

Example   The first example below changes the name of file "OLD.OLD" in drive A: to "NEW.NEW". The second example changes just the file name extension.

```
A>DIR
A: OLD        OLD
A>REN A:NEW.NEW=OLD.OLD
A>DIR
A: NEW        NEW
A>REN NEW.DAT=NEW.NEW
A>DIR
A: NEW        DAT
A>
```

SAVE

Format   SAVE number-pages d:filename.ext

Function   Saves the specified number of pages of the transient program area to disk under the specified file name.

The SAVE command saves the specified number of pages (1 page = 256 bytes) of the memory area starting at address 0100H to disk.
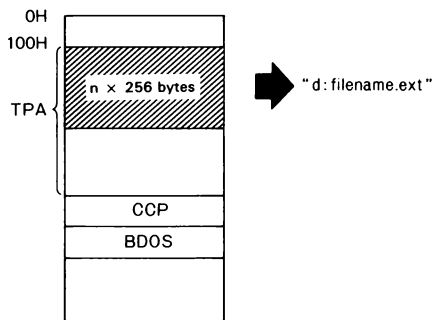
Example   The following example saves the 4-page (1024-byte) area starting at address 0100H to drive A: under the file name "TEST.DAT".

```
A>DIR
NO FILE
A>SAVE 4 A:TEST.DAT
A>DIR
A: TEST    DAT
A>
```

TYPE

Format   **TYPE d:filename.ext**

Function   **Displays the contents of ASCII text files on the display screen.**

The TYPE command displays the contents of the specified file on the display screen. However, only files which have been saved in ASCII format (as character codes) can be displayed; if any other type of file is specified, display will be meaningless.

Example   The following example illustrates use of the TYPE command to display a BASIC program file which has been saved in ASCII format.

(BASIC)

```
LIST
10 PRINT "A"
20 PRINT "B"
30 PRINT "C"
40 PRINT "D"
50 PRINT "E"
60 END
Ok
SAVE "A:TEST.BAS",A
Ok
```

(CCP)

```
A>TYPE A:TEST.BAS
10 PRINT "A"
20 PRINT "B"
30 PRINT "C"
40 PRINT "D"
50 PRINT "E"
60 END

A>
```

USER

USER n

Switches to the specified user area in a disk drive.

A user area is a physical area on a disk which has its own directory and which is managed separately from the rest of the disk. Data cannot be read from or written to any user area other than that in which CP/M is currently operating. A disk can be divided up into a maximum of 16 user areas. The USER command switches CP/M operation from one user area to another.

The following example shows that data in one user area (area 0) cannot be read while CP/M is operating in another (area 1).

```
A>USER 0
A>DIR
A: TEST      DAT
A>USER 1
A>DIR
NO FILE
A>
```

2.7.3 Transient commands

A transient command is a program which is loaded into the transient program area (TPA, the area starting at address 0100H) from a disk drive for operation when the command is executed. Representative transient commands of CP/M are PIP and STAT.

2.7.4 Error messages

If any error is encountered during file processing, BDOS (the basic disk operating system) displays one of the following error messages. In these messages, the characters displayed for "d:" indicate the applicable drive name.

BDOS ERR ON d:BAD SECTOR

Indicates that an error occurred during input or output processing; there is something wrong with the disk drive or the floppy disk in the drive. After the cause of the error has been eliminated, processing can be resumed by pressing any key.

BDOS ERR ON d:SELECT

BDOS does not recognize the drive name which was specified in a command. A warm start is made when any key on the keyboard is pressed.

BDOS ERR ON d:READ ONLY

An attempt was made to write data to a read-only drive (a drive for which the read-only attribute has been set with the STAT command). A warm start is made when any key on the keyboard is pressed. This error will also occur if an attempt is made to write data to a disk which was inserted in a drive which previously contained a different disk. In this case, the read-only condition can be cleared by pressing CTRL + C or STOP .

BDOS ERR ON d: FILE READ ONLY

This message appears when you try to erase, rename, or set file attributes of a Read-Only file. The file should first be set to Ready-Write (RW) with the command: "STAT filespace $R/W."

2.8 Microcassette Handling

When PX-4's optional microcassette drive is installed, microcassettes can be used for file storage in much the same manner as with the RAM disk or floppy disk drives. The drive name of the microcassette drive is H:.
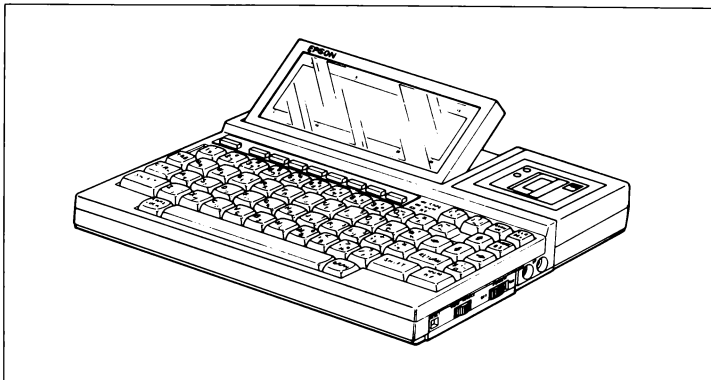
As with disk drives, microcassette files are managed using a file directory (a directory containing information regarding files which are present). This directory must be loaded into memory from tape before microcassette files can be read or written. The processing of loading the directory into memory is referred to as "mounting" the tape. Once the tape has been mounted, PX-4 manages files on the tape based on information contained in the directory in memory. If data is written to the tape, the contents of the directory in memory are changed. Therefore, when operation is completed the directory must be written back onto the tape from memory before unloading the tape from the drive. This operation is referred to as "removing" the tape.

Once the tape has been removed, the FREE lamp (green) on the microcassette drive lights. Before unloading a tape, always verify that the FREE lamp is lit. (Since the FREE lamp will light only if PX-4's power is turned on, always make sure that the power is on and that the FREE lamp is lit before unloading the tape.)

Directory | //////// | File 0 | File 1 | | |

|◀─────── One tape ───────▶|
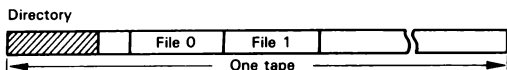
It is very important to remember to do the "remove" operation before unloading a tape.

If the tape is taken out of the microcassette drive without updating the directory by doing the "remove" operation, all data written to the tape will be lost.

Tapes are mounted or removed by pressing `CTRL` + `HELP` to switch to the System Display, then pressing one of function keys. During BASIC operation, tapes can be mounted and removed by executing the MOUNT and REMOVE statements.
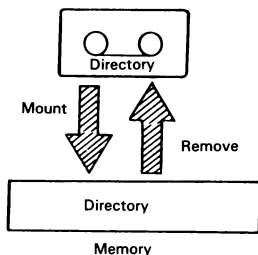
If the tape in the drive is not already mounted, it is mounted automatically whenever drive H: is specified in CP/M commands (such as DIR or ERA) or BASIC statements (such as FILES, SAVE, and LOAD).

Therefore, it is not necessary to explicitly mount each tape which is accessed. However, the "remove" operation is not performed automatically, so be sure to remember to do the remove operation before unloading tapes from the drive.

When the remove operation is done (either from the System Display or from BASIC), directory information is written to tape from memory only if data has been recorded to the tape since it was last mounted. (The directory is not updated if nothing has been written to the tape because the directory information remains the same as when the tape was mounted.)

Once a tape has been mounted, it is not possible to execute the "mount" function from the System Display; if the MOUNT statement of BASIC is executed while a tape is already mounted, an "AC Error" will result. An "AC Error" will also result if the REMOVE statement of BASIC is executed when no tape has been mounted. In other words, the "mount" and "remove" functions can only be done in alternation.

When a file is written to tape, the write operation always starts at the point on tape which immediately follows the end of the last file written. This applies whether or not the file is being written to the tape for the first time.

NOTES:
1. *Always make sure that the FREE lamp is lit before unloading tape from the microcassette drive. If the power is not on, turn on the power switch and make sure that the FREE lamp is lit.*

   FREE (green): *When lit, indicates that tape may be unloaded from the microcassette drive.*

   REC (red): *When lit, indicates that data is being written to the microcassette tape.*

2. *Make sure than the microcassette drive is closed before doing the "remove" operation.*
3. *Before initializing the microcassette directory, verify that the record lock-out tabs on the microcassette are not broken.*
4. *When drive H: (the microcassette drive) is specified in the STAT command, the value which is returned is meaningless.*
5. *To prevent accidental erasure of tapes which contain important data, break off the microcassette's record lock-out tabs. Once these tabs have been broken off, the tape cannot be recorded or erased.*
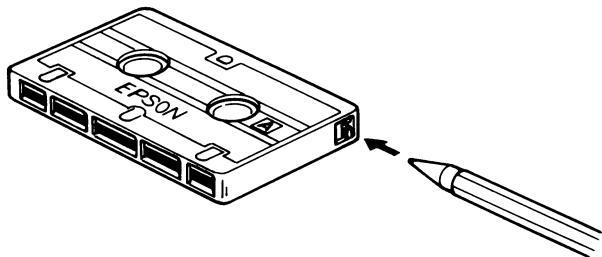
Manual microcassette operation

When the microcassette drive is installed, certain microcassette operations can be performed manually from the System Display. The appearance of the System Display changes as follows when the microcassette drive is installed.

```
┌─────────────────────────────────────────────────┐
│ * SYSTEM DISPLAY *   05/05 (SAT) 17:06:56        │
│ <RAM   DISK> 026      KB  <ALRM> OFF             │
│ <USER  BIOS> 000×256 B    <AUTO> OFF            │
│ <MENU DRIVE> CBA          <MENU> ON             │
│ <MCT  COUNT> 00000                              │
│ -Select or ESC to exit.   1=RAM cartridge       │
│ 2=alarm   3=auto start    4=menu   5=MCT         │
│   <<-/       <-/mou   ▓/dint  ->>/era  ooo/      │
└─────────────────────────────────────────────────┘
```

The value following <MCT COUNT> in the screen indicates the present value of the microcassette drive's tape counter. The "5 = MCT" option in this screen can be selected to specify items which determine microcassette drive operating mode (the manner in which the drive operates). On the bottom line, < < − indicates that the tape can be manually fast-forwarded by pressing the PF1 key, "mou" indicates that the tape can be mounted by pressing SHIFT + PF2, and so forth.

After the directory of a new tape has been initialized or a previously initialized tape has mounted, the screen changes as shown below.

```
┌─────────────────────────────────────────────────┐
│ * SYSTEM DISPLAY *   05/05 (SAT) 00:05:13        │
│ <RAM   DISK> 026      KB  <ALRM> OFF             │
│ <USER  BIOS> 000×256 B    <AUTO> OFF            │
│ <MENU DRIVE> CBA          <MENU> ON             │
│ <MCT  COUNT> 00191                              │
│ -Select or ESC to exit.   1=RAM cartridge       │
│ 2=alarm   3=auto start    4=menu   5=MCT         │
│   /rem        /          /        /        /     │
└─────────────────────────────────────────────────┘
```

With this screen, the only microcassette operation which can be performed is the "remove" operation.

Commands and statements related to microcassette operation are summarized in the table below.

Operation	Function	System Display control	BASIC statements
MOUNT	Reads the tape directory.	[SHIFT] + [PF2] (mou)	MOUNT
REMOVE	Writes the tape directory.	[SHIFT] + [PF1] (rem)	REMOVE
DIRINT	Initializes the tape directory.	[SHIFT] + [PF3] (dint)	----------
REWIND	Rewinds the tape.	[PF4] (— > >)	WINDn (where n is the tape counter value). Tape is rewound only if n is less than the present counter value.
PLAY	Outputs the contents of the tape to the speaker.	[PF2] (< —)	WIND ON
FF	Fast-forwards the tape.	[PF1] (< < —)	WINDn (where n is the tape counter value). Tape is fast-forwarded only if n is greater than the present counter value.
ERASE	Erases the tape.	[SHIFT] + [PF4] (era)	----------
STOP	Stops the tape.	[PF3] (▦)	WIND OFF
RESET	Resets the tape counter to 0.	[PF5] (000)	TAPCNT = 0

Setting the microcassette mode

The microcassette drive access mode can be set by selecting "5 = MCT" from the System Display. When "5 = MCT" is selected, the screen changes as shown below.

```
* SYSTEM DISPLAY *   05/05 (SAT) 00:06:29
<RAM   DISK>  026     KB    <ALRM> OFF
<USER  BIOS>  000×256 B     <AUTO> OFF
<MENU DRIVE>  CBA           <MENU> ON
<MCT   COUNT> 00191
-Select or ESC to return.
  <MCT>      stop    nonverify
  1=stop 2=nonstop 3=verify 4=nonverify
```

<Stop mode and non-stop mode>

In the stop mode, the microcassette drive stops running after each block of data has been read or written, and does not start running again until read or write operation begins for the next block. In contrast, the microcassette drive runs continuously when it is used in the non-stop mode (that is, it does not stop running from the time a file is opened until the time that file is closed). Ordinarily, the stop mode is used when processing involving arithmetic calculations or the like is done in the interval between access to each block, and the non-stop mode is used when only data transfer (such as with the PIP command of CP/M or the SAVE command of BASIC) is involved. Access takes longer when the stop mode is used because it takes a certain amount of time to start and stop the drive motor.

Microcassette drive operation can be switched to the stop mode selectiong "1 = stop", and to the non-stop mode by selecting "2 = nonstop".

Example 1: This example graphically illustrates the difference in the amount of tape which is used to store a file with the stop and non-stop modes when lengthy processing is done between the time each block is written.
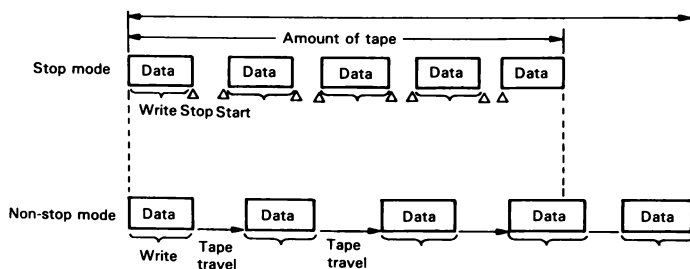
Example 2: This example illustrates the difference in the amount of tape which is used to store a long file with the stop and non-stop modes when only data transfer is involved.

<Verify mode and non-verify mode>
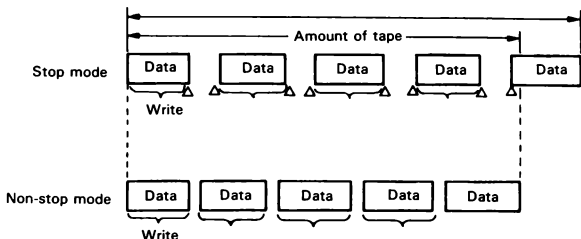
In the verify mode, the tape is automatically rewound after a file has been written, then the file is read to verify that data has been properly recorded; if any data error is detected while the tape is being read, the microcassette drive stops and an error message is displayed. This operation is not performed when data is written to the microcassette drive in the non-verify mode.

Microcassette drive operation can be switched to the verify mode by selecting "3 = verify", and to the non-verify mode by selecting "4 = non-verify".

2.9 Charging and Replacing the Main Battery

When the main battery voltage drops below a certain level while PX-4 is being used, the following screen appears, then PX-4 automatically shuts itself off.

```
                    CHARGE BATTERY
```

When this message appears, the main battery must be recharged or replaced. When using dry cells, replace them as described in section 2.1, "Introduction to Operation." When using the NiCd battery pack, recharge it as follows.

1. Turn off the power switch.
2. Plug the AC adapter cable into the ADAPTER connector, then plug the AC adapter into an AC power outlet.
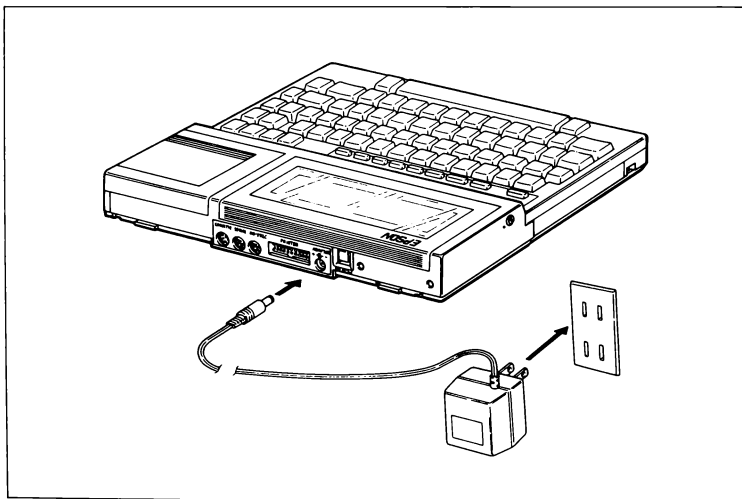
3. Charging takes about 8 hours if PX-4 is not used during charging, and about 11 hours if PX-4 is used (provided no input/output processing is performed). However, the battery may not be fully charged if PX-4 is used during charging.

Installing the NiCd battery pack

Procedures for installing the NiCd battery pack are as follows.
1. Turn off the power switch.
2. Open the battery compartment cover on the bottom of PX-4.
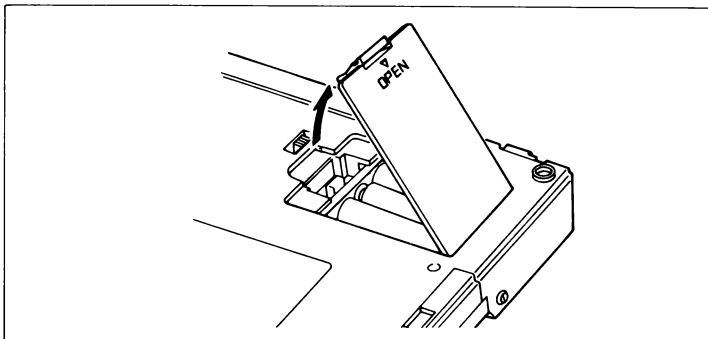
3. Verify that the battery backup switch next to the battery compartment is set to ON.

Batttery backup switch
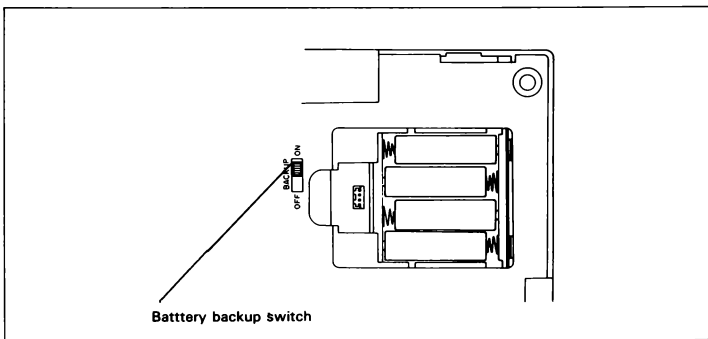
4. Remove dry cells from the battery compartment.

Battery terminal plate
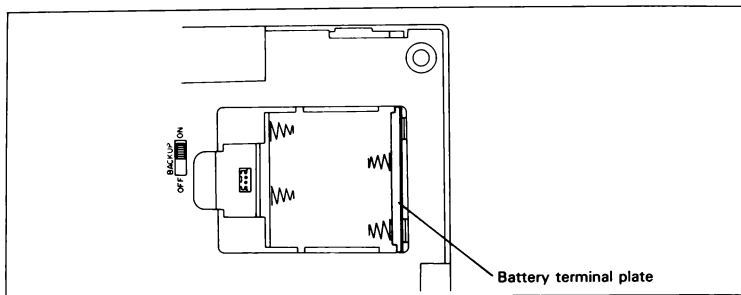
5. Move the battery terminal plate to the position shown in the figure below.
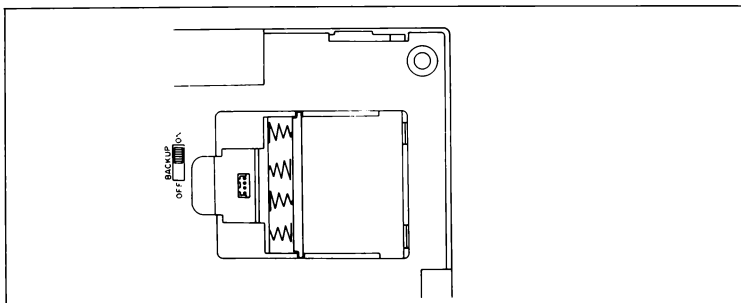
6. Plug the NiCd battery pack connector lead into the connector socket.
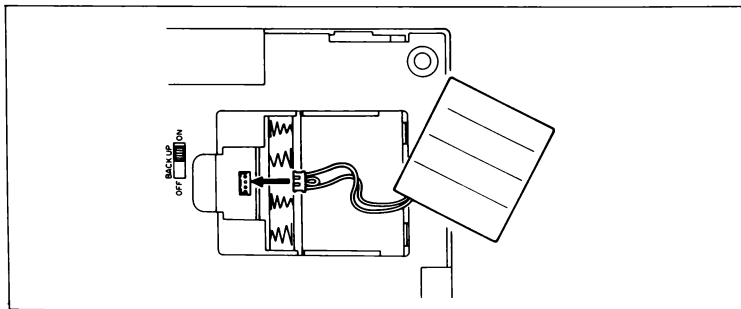
7. Push the battery terminal plate all the way to the side and insert the NiCd battery pack.
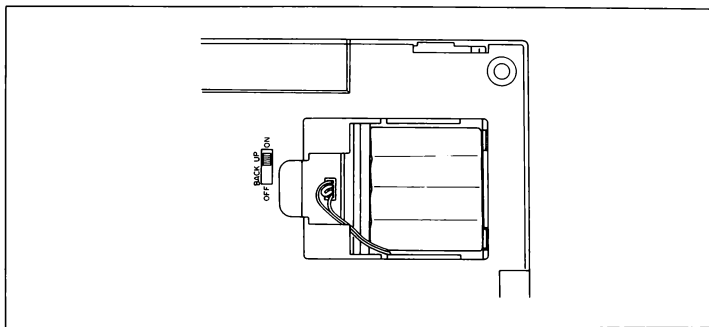
8. Close the battery compartment cover.
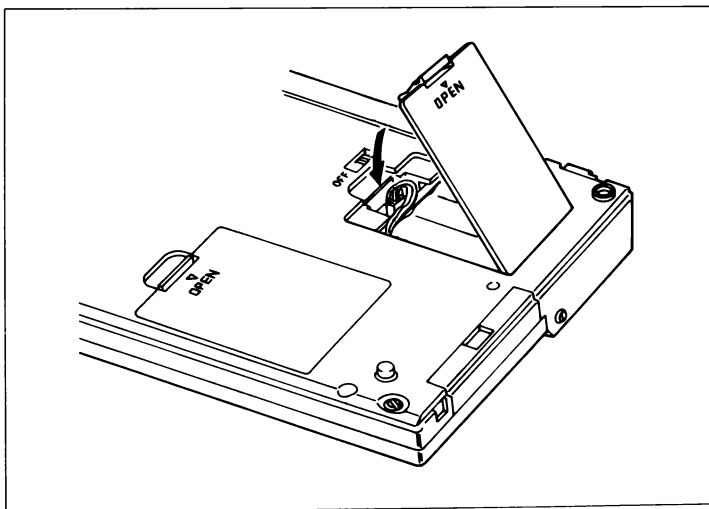
2.10 ROM Capsule Replacement

A ROM capsule can be thought of a disk drive which contains prerecorded application programs. When necessary, ROM capsules can be replaced to allow different application programs to be used. Up to two ROM capsules can be installed in PX-4 at the same time, and different device names (B: and C:) are assigned to each ROM capsule. When the optional ROM cartridge is used, two additional ROMs can be installed (device names assigned to ROMs in the ROM cartridge are J: and K:).

Procedures for replacing ROM capsules are as follows. Be sure to turn off the power before replacing the ROM capsules.

1. Set the power switch to OFF.
2. Open the ROM capsule compartment on the bottom of PX-4.
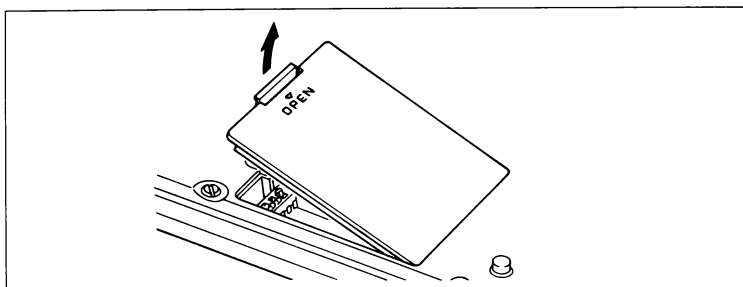
3. Grip the ROM capsule by the ends with your fingers and slowly work the capsule out of its socket by pulling the ends up slightly in alternation. Do not rock the capsule from side to side.
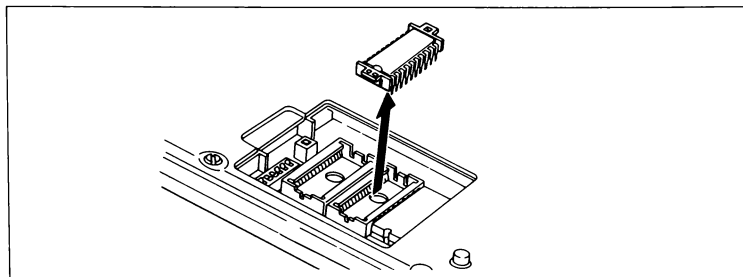
4. Insert the new ROM capsule. Verify that the pins of the ROM capsule are seated properly in the socket, and make sure that the end with the notch is positioned as shown in the figure below.
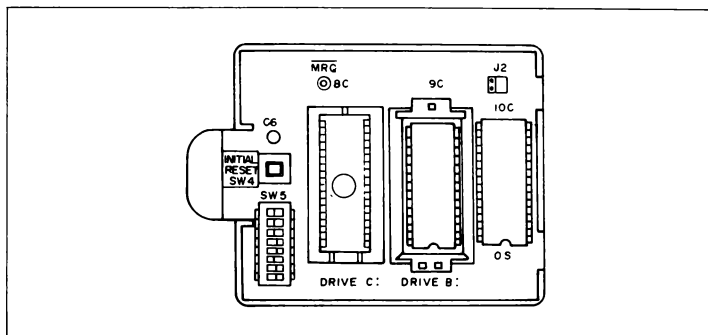
5. Replace the ROM capsule compartment cover.
6. Turn on the power switch.

   NOTE:
   System operation may be disrupted if a ROM capsule is removed or installed without turning off the power.

Chapter 3

STANDARD INPUT/OUTPUT INTERFACES

Input/output interfaces are the part of the hardward system through which PX-4 exchanges data with external devices such as printers or other computers. These signals make it possible for PX-4 to receive data for processing from other external devices, or to output drive/control signals and data to optional devices. All interfaces except the bar code reader are supported by BIOS of CP/M or BASIC (no standard software support is provided for the bar code reader interface).

This chapter describes the functions of PX-4's eight standard input/output interfaces and procedures for using them.

3.1 Speaker Interface

An external speaker can be connected to PX-4's external speaker interface. When an external speaker is connected, speaker output goes to the external speaker instead of to the speaker which is built into PX-4. Speakers (or earphones) which can be connected must have a nominal impedance of at least 100 ohms.
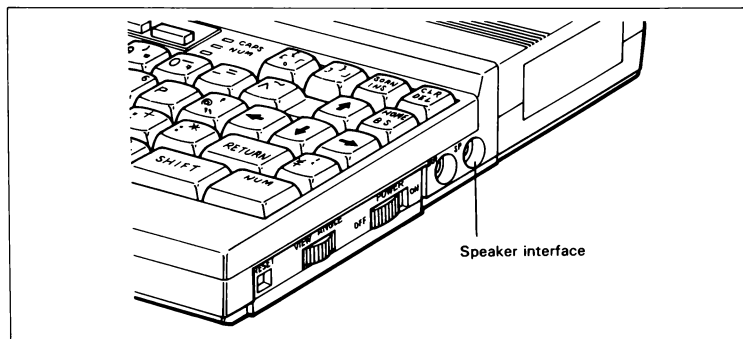
Speaker interface

3.2 Bar Code Reader Interface

The bar code reader interface makes it possible to connect an optional bar code reader (the H00BR CODE JA) to PX-4. Utility software (sold separately) which supports the bar code reader must be installed in order to use the bar code reader.

Bar code reader interface
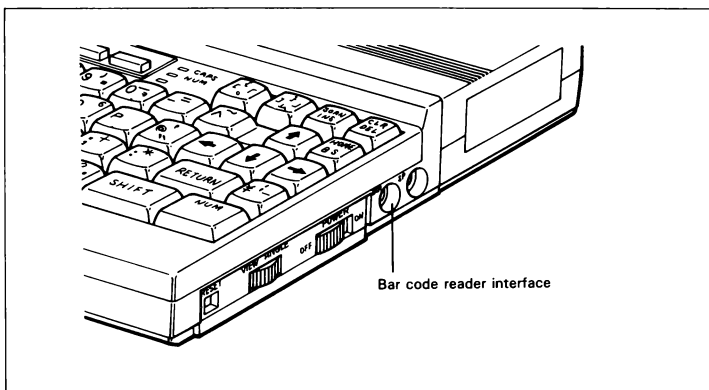
3.3 External Audio Cassette Interface

PX-4 supports the external audio cassette interface as a sequential input/output device. When an external cassette recorder is connected to this interface, it can be accessed from BASIC under the device name "CAS0:".

External audio cassette interface
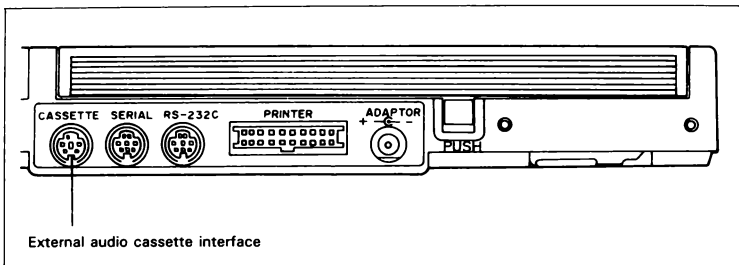
If you wish to use an external cassette recorder, connect it to PX-4 using cable set #732.

5-pin miniature DIN connector (female)
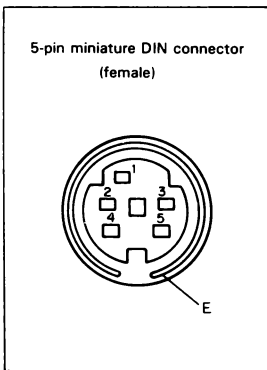
Pin No.	Symbol	Signal Direction	Signal Name
1	GND	—	Ground
2	RMT	OUT	Remote output
3	RMT	OUT	Remote output
4	MIC	IN	Microphone input
5	EAR	OUT	Earphone output
E	—	—	—

3.4 Serial Interface

PX-4's serial interface makes it possible to connect a floppy disk unit (the PF-10, TF-15) or serial printers (printers which are equipped with the RS-232C interface) to PX-4.

Serial interface
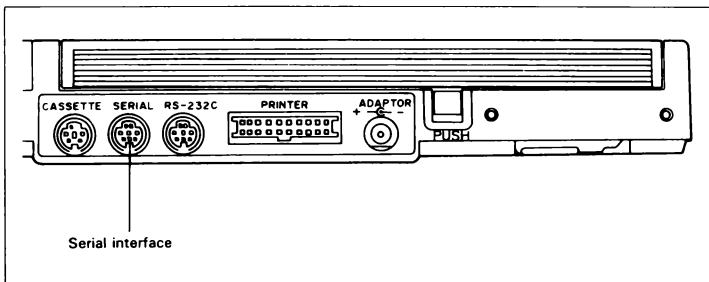
The communication protocol used with floppy disk units differs from that used for printers as shown below.

> **Floppy disk units**
> Bit rate: 38,400 bps
> Control lines used: None (control is by software)
>
> **Printers**
> Bit rate: 4,800 bps (see Note 2 below)
> Control lines used: Printer DSR line

Cables which can be connected to the serial interface must be equipped with an 8-pin miniature DIN connector. When connecting a printer, use cable set #725; when connecting a floppy disk unit, use one of the cable sets indicated below.

> PF-10 or TF-15 Cable set #726

The assignments of connector pins on PX-4 are as follows.

NOTES:
1. *When connecting the P-40 or P-80 printer, use cable set #723.*
2. *Bit rate settings which can be made with the optional CONFIG command are as follows.*
   110, 150, 200, 300, 600, 1100, 2400, 4800, 960, 19200, or 38400 bps

8-pin miniature DIN connector

(female)

E
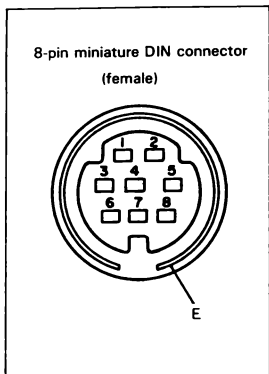
Pin No.	Symbol	Signal Direction	Signal Name
1	GND	—	Ground
2	PTX	OUT	Transmitted data
3	PRX	IN	Receive data
4			
5			
6	PIN	IN	Status ready
7	POUT	OUT	Control signal
8			
E	CGND	—	Frame ground

NOTE:
Signal direction is as viewed from PX-4.

3.5 RS-232C Interface

RS-232C is the designation of the Electronic Industries Association (EIA) for a standard which defines interfaces for connecting computer terminals to acoustic couplers or modems.
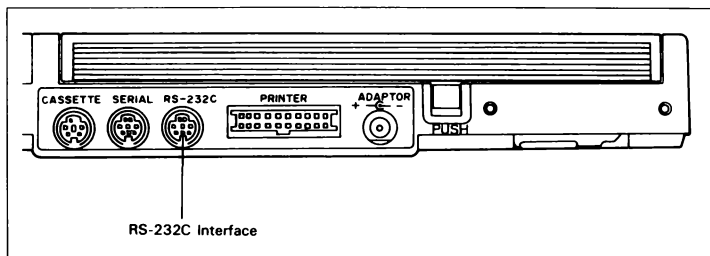
RS-232C Interface

The RS-232C interface is provided primarily to allow the CX-21 acoustic coupler to be connected to PX-4, enabling communications with other computers via public telephone lines. The interface can also be used to connect PX-4 directly to other computers (such as another PX-4 or the QX-10) which are equipped with the RS-232C interface. In the later case, a special cable must be used to connect the two computers.

When a printer which is equipped with an RS-232C interface is used, it can be connected to this interface or the serial interface.

3.5.1 Signal lines

Cables which are connected to the RS-232C interface must be equipped with an 8-pin miniature DIN connector. When connecting the CX-21 acoustic coupler, use cable set #725. When connecting PX-4 to another PX-4 or the QX-10, use cable set #726.

NOTE:
When connecting the P-40 or P-80 printer, use cable set #723.

The assignments of RS-232C connector pins on PX-4 are as follows.

8-pin miniature DIN connector (female)
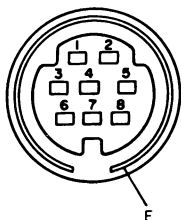
Pin No.	Symbol	Signal Direction	Signal Name
1	GND	—	Ground
2	TXD	OUT	Transmitted data
3	RXD	IN	Receive data
4	RTS	OUT	Request to send
5	CTS	IN	Clear to send
6	DSR	IN	Data set ready
7	DTR	OUT	Data terminal ready
8	DCD	IN	Data carrier detect
E	CGND	—	Frame ground

NOTE:
Signal direction is as viewed from PX-4.

Functions of the various signals are as follows.

GND (Ground)
Provides the reference voltage (ground) with respect to which the levels of other signals are determined. Connected to the ground line on the modem or acoustic coupler.

TxD (Transmitted data)
Signal line used for data output to the connected device.

RxD (Receive data)
Signal line used for data input from the connected device.

RTS (Request to send)
Signal line used by the computer to control a modem or acoustic coupler. When this signal is ON, the modem's carrier signal is output to prepare for transmission.

CTS (Clear to send)
Line which informs the computer of the status of the modem or acoustic coupler. When ON, the modem (acoustic coupler) is ready to receive data for output to the telephone line, indicating that the computer may begin sending.

DSR (Data set ready)
This signal line informs the computer of the status of the data set (the modem or acoustic coupler connected to the interface). When ON, the modem (acoustic coupler) is turned on and is ready for operation.

DTR (Data terminal ready)
This signal line informs the modem (acoustic coupler) of the computer's status. When ON, the computer is turned on and ready for operation.

DCD (Data carrier detect)
Signal line used for detecting the carrier signal from the connected device (modem or acoustic coupler).

CGND (Frame ground)
Connected to the PX-4's chassis. Ordinarily, also connected to the corresponding terminal on the other device.

3.5.2 Data transfer prototol — Data transfer via acoustic coupler

The figure below illustrates the steps involved in data transfer between two computers over a telephone using the RS-232C interface and acoustic couplers. In this figure, data is transferred from computer A to computer B.
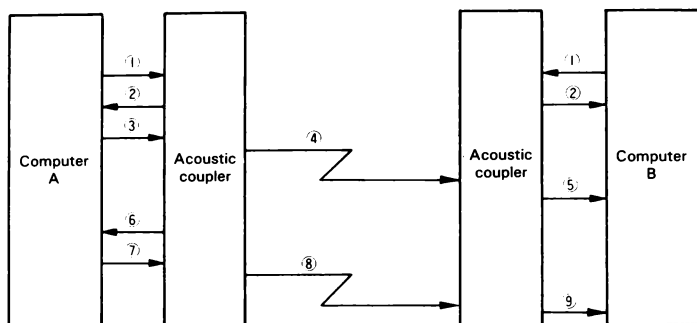
1. Computers A and B inform their acoustic couplers that they are ready for operation by outputting the DTR signal.
2. Computers A and B check the DSR signal to verify that the acoustic couplers are ready for operation.
3. Computer A outputs the Request to send (RTS) signal to its acoustic coupler.
4. The acoustic coupler prepars for transmission by outputting the carrier signal to the telephone line.
5. Computer B verifies that the carrier is present by checking the Data carrier detect (DCD) line.
6. Computer A verifies that its acoustic coupler is ready for transmission by checking the Clear to send (CTS) line.
7. Computer A outputs data to the acoustic coupler over the Send data (TxD) line.
8. Computer A's acoustic coupler converts data into an acoustic signal (modulates it) and outputs it to the telephone line.
9. Computer B's acoustic coupler receives the acoustic signal from the telephone line, converts it back into a digital signal (demodulates it), and sends it to computer B over the Receiv3e data (RxD) line.

3.5.3 Pin connections of the RS-232C interface

The manner in which the pin of the RS-232C interface are connected differs according to whether PX-4 is being connected directly to another computer or is connected via an acoustic coupler.

NOTE:
The communication format (bit rate, parity, number of stop bits, number of bits per character, etc.) which is used may also differ according to whether an acoustic coupler is used. See section 3.5.4 concerning the communication format.

Connection to an acoustic coupler

When an acoustic coupler is connected to PX-4, pins in the acoustic coupler must be connected to their counterparts on PX-4. This is illustrated below.

PX-4   Acoustic coupler
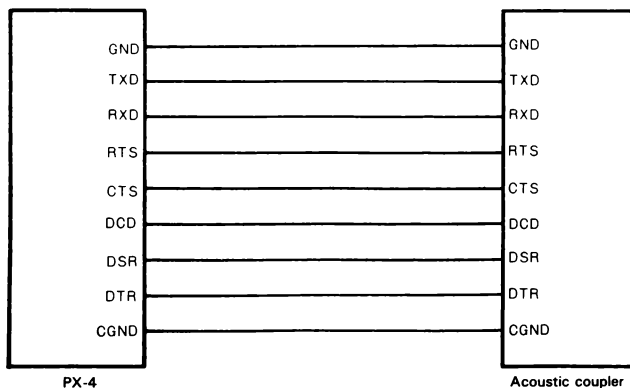
When using an acoustic coupler, connect it to PX-4 using cable set #724.
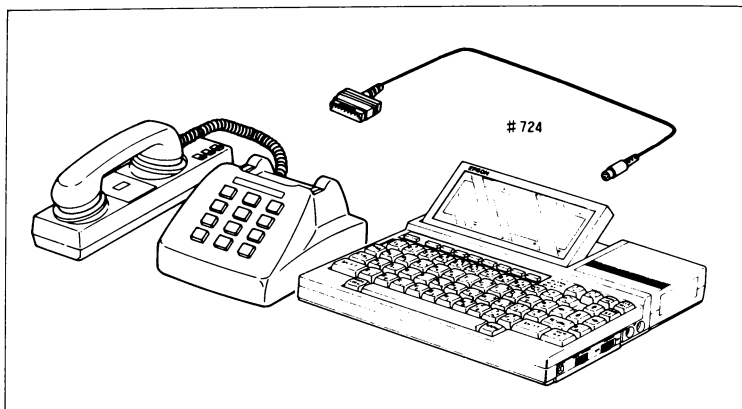
Direct connection to another computer

The figure below illustrates one of several possible methods which can be used to connect PX-4 directly to another computer via the RS-232C interface.
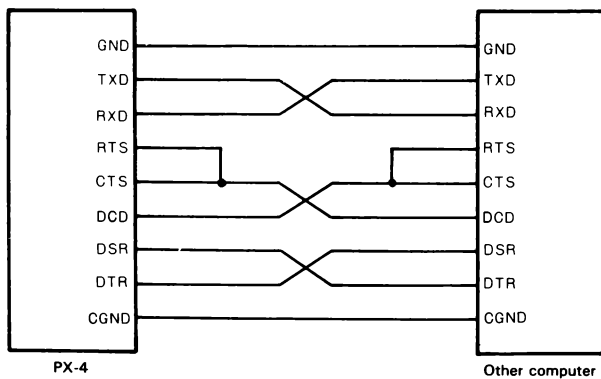
When connecting PX-4 to another PX-4 computer, use a null modem cable (cable set #726).
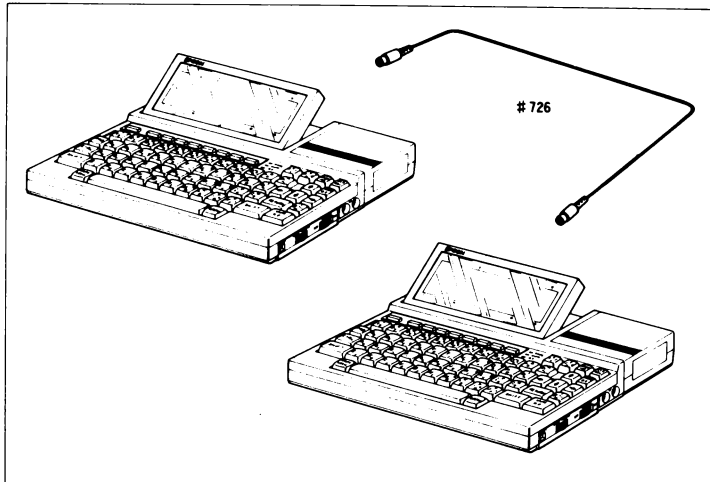
When connecting PX-4 to a printer which is equipped with an RS-232C interface or to an EPSON QX-10, use cable set #725.
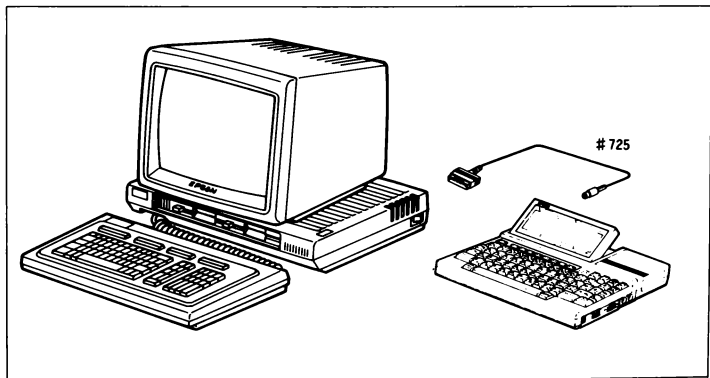
If data is to be transferred between PX-4 and another computer without using the data transfer protocol described above, connections may be made as shown below.

PX-4   Other computer
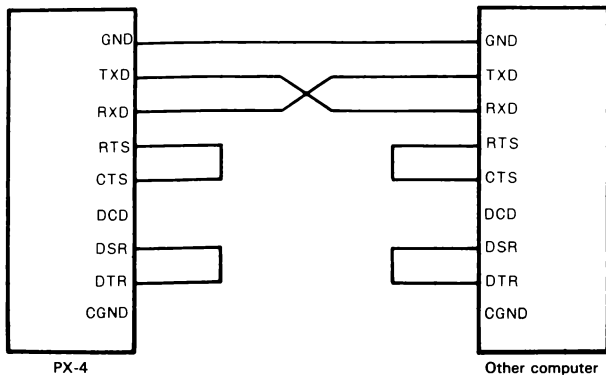
EPSON does not currently provide any cable for making the type of connection shown above.

NOTE:
The BIOS subroutine which provides control over the RS-232C interface is the RSIOX routine. See Appendix C "BIOS SUBROUTINES" for further information.

3.5.4 Data transfer format

When data is transferred via the RS-232C interface, the bits of each byte (character) are transferred serially, starting with the least significant bit (bit 0) and ending with the most significant bit (the highest bit). The bits of data making up each byte are preceded by a start bit and followed by one or two stop bits; the start bit and stop bit(s) make it possible for the receiving computer to keep track of the where each character starts and stops (this method is referred to as start-stop transmission).

As was explained in the previous section, start-stop transmission involves connection of various control signal lines and two data signal lines. Separate data signal lines are used for sending data (the TxD line) and receiving data (the RxD line).

The data transfer format (TxD and RxD) is as follows.
- Each character of data is separated from the others by a start bit and one or two stop bits.
- Each character of data is made up of 7 or 8 data bits.
- A parity bit may be included immediately before the stop bit. When parity bits are included, either even parity or odd parity may be specified (with even parity, the parity bit is "0" if there is an even number of "1" data bits, and is "1" if there is an odd number of "1" data bits; the opposite is true when odd parity is used).

For example, the data format is as follows when there is one stop bit, each byte consists of eight data bits, and no parity bit is included. (The data transfer format can be set with the OPEN statement of BASIC or with the RSIOX routine of BIOS.) Here, it is assumed that the character being transmitted is that whose hexadecimal code is 3AH.
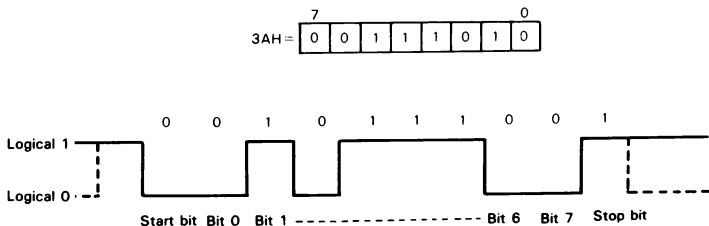
Since the actual voltage level on the signal line is −5V for a logical "1" and +5V for a logical "0", the voltage level on the line changes as follows when 3AH is sent as shown above.
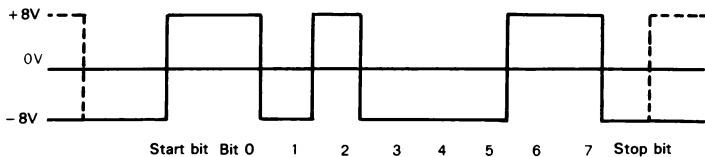
3.5.5 Communication speed

PX-4's RS-232C interface supports communication speeds from 110 to 38,400 bits per second (bps).

The communication speed can be set with the OPEN statement of BASIC, the RSIOX routine of BIOS, or the optional CONFIG command.

3.5.6 Shift-in/shift-out (SI/SO)

"Shift-in" and "shift-out" are control codes which are used for converting characters between the 7-bit and 8-bit code systems. When these codes are included in data transferred, conversion is performed as shown below.

During transmission
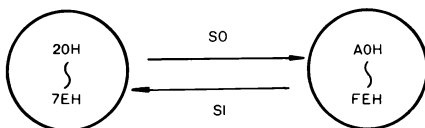
During reception

- After receiving an SI code, the receiving computer unconditionally sets bit 7 of all characters received to zero.
- After receiving an SO code, the receiving computer converts the following codes as indicated and leaves other codes unchanged.

        20H ~ 7EH - - - - - - - ► A0H ~ FEH

3.5.7 XON/XOFF

When the speed of data transmission is higher than the speed with which data received can be processed, a receive buffer overflow is likely to occur; in other words, the receive buffer becomes completely full and incoming data is lost (this never occurs if the size of the receive buffer is greater than the amount of data received). The XON/XOFF function is provided to make it possible to avoid data loss in such cases. When the function is used, the receiving computer outputs an XOFF code to the RS-232C interface whenever the receive buffer becomes 3/4 full. When the sending computer is also using the XON/XOFF function, this tells it to stop sending.

While the sending computer waits, the receiving computer continues processing data in the receive buffer. When the buffer becomes 3/4 empty, the computer outputs the XON code to the sending computer to tell it that transmission can be resumed. When the sending computer receives the XON code, it resumes transmission at the point at which it was interrupted.

The XOFF command is CTRL + S (13H), and the XON command is CTRL + Q (11H).

Whether or not the XON/XOFF function is used is determined at the time the RS-232C interface is opened by the OPEN statement of BASIC or the RSIOX routine of BIOS.

3.6 Printer Interface

PX-4 is equipped with a Centronics-type parallel interface which makes it possible to connect PX-4 to similiarly equipped printers. When connecting such a printer to PX-4, use cable set #731.

Printer interface
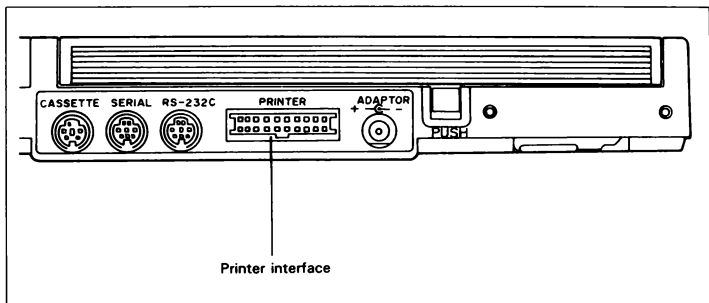
Types of printers which can be connected to PX-4 are listed in 4.2 "Printers".
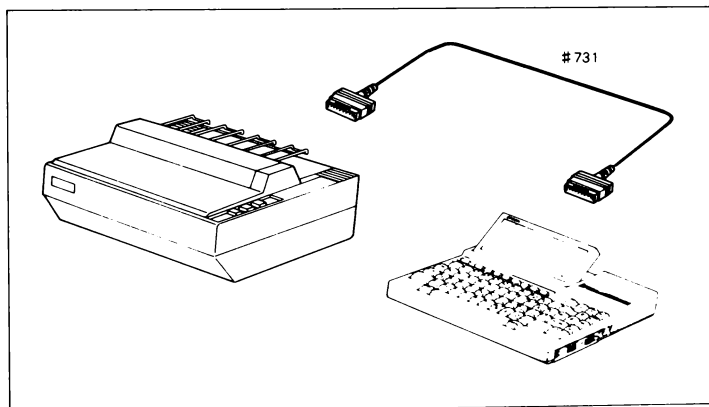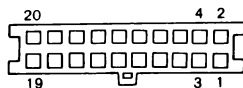
Pin No.	Symbol	Direction	Signal Name
1	CG	—	Ground
2	CG	—	Ground
3	PD7	OUT	Parallel data
4	BSY	IN	Printer busy
5	PD6	OUT	Parallel data
6	+5	—	+5V power supply
7	PD5	OUT	Parallel data
8	+5	—	+5V power supply
9	PD4	OUT	Parallel data
10	GND	—	Signal ground
11	PD3	OUT	Parallel data
12	$\overline{\text{ERR}}$	IN	Error signal from printer
13	PD2	OUT	Parallel data
14	GND	—	Signal ground
15	PD1	OUT	Parallel data
16	$\overline{\text{INIT}}$	OUT	Reset signal
17	PD0	OUT	Parallel data
18	GND	—	Signal ground
19	$\overline{\text{STB}}$	OUT	Strobe signal
20	—	—	—

NOTE:
Signal direction is from the point of view of PX-4.

3.7 System Bus

The connector on the inside of the cover on the side of PX-4 is the system bus. The external RAM disk unit is connected to this connector.
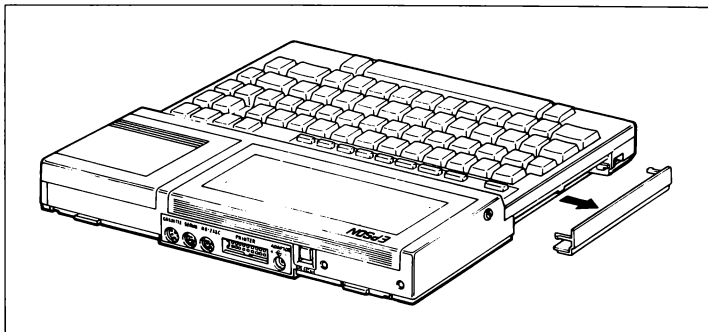
See Appendix A "HARDWARE SPECIFICATIONS" for details on the system bus.

3.8 Cartridge Interface

A cartridge interface is provided to the side PX-4's LCD screen which makes it possible to connect a variety of cartridge-type options. Options currently available as cartridges are as listed below. For details, see 4.1 "Cartridge Options".

1. RAM cartridge
2. ROM cartridge
3. Microcassette drive
4. Universal cartridge
5. Digital multimeter cartridge
6. Cartridge printer

Cartridge interface
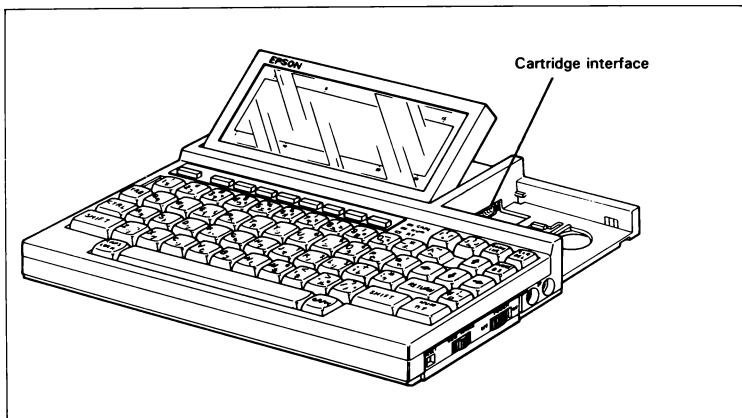
Cartridge interface
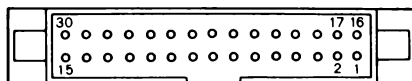
Pin No.	Symbol	Direction	Signal Name
1	GND	—	Signal ground
2	CAUD	IN	Digital audio input signal
3	CDB4	I/O	Data bus
4	CRD	I/O	Read signal
5	CDB0	I/O	Data bus
6	CITO	OUT	Interrupt signal to cartridge
7	CCS	I/O	Chip select
8	CRS	OUT	Reset
9	CAB0	I/O	Address bus
10	CSEL	IN	Option select signal
11	GND	—	Signal ground
12	CDB2	I/O	Data bus
13	VB1	—	Battery
14	CRXD	IN	Serial receive data
15	− 5V	—	− 5V power supply
16	+ 5V	—	+ 5V power supply
17	CG	—	Frame ground
18	CDB1	I/O	Data bus
19	CG	—	Frame ground
20	CAB1	I/O	Address bus
21	FPOF	OUT	Power failure signal
22	CDB7	I/O	Data bus
23	CDB3	I/O	Data bus
24	CEN	IN	6301EN signal
25	CWR	I/O	Write signal
26	CTXD	OUT	Serial send data
27	CDB6	I/O	Data bus
28	RS	OUT	Hardware reset
29	CDB5	I/O	Data bus
30	VB2	—	Backup power supply

NOTE:
Signal direction is from the point of view of PX-4.

Chapter 4

OPTIONAL DEVICES

This chapter describes optional devices which can be used with PX-4 and procedures for connecting them.

4.1 Cartridge Options

The cartridge interface located next to PX-4's LCD screen makes it possible to connect a variety of cartridge-type options. The cartridge options are as listed below.

1. RAM cartridge
2. ROM cartridge
3. Microcassette drive
4. Universal cartridge
5. Digital multimeter cartridge
6. Cartridge printer

These optional cartridges are installed in the location indicated in the figure below.

> **WARNING:**
> *Be sure to turn the power off before installing or removing any cartridge option.*
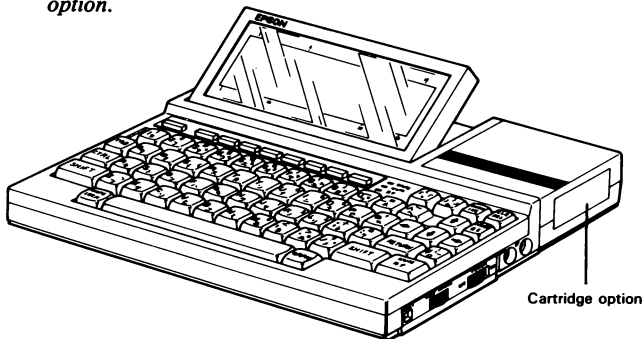
Cartridge option

Cartridge option installation

1. Turn off the power switch.
2. Remove the dummy cartridge as follows. First, move the cartridge lock switch toward FREE.
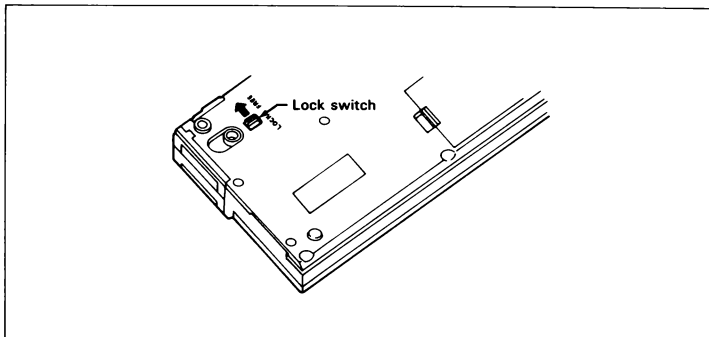
3. Hook your finger in the cartridge release ring at the bottom of the cartridge and pull in the direction indicated by the arrow in the figure below.
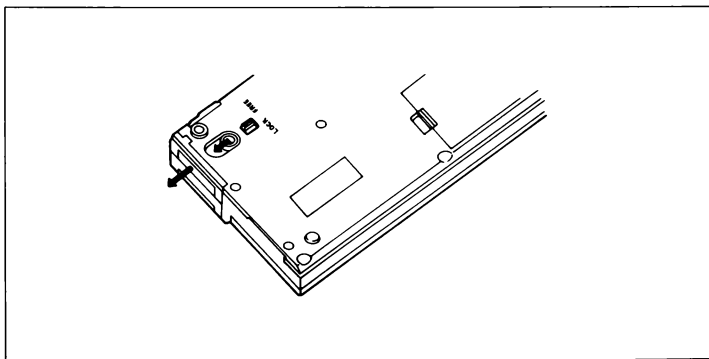
4. Next, place the cartridge to be installed in the cartridge slot so that its release ring fits into the hole in PX-4's bottom panel.
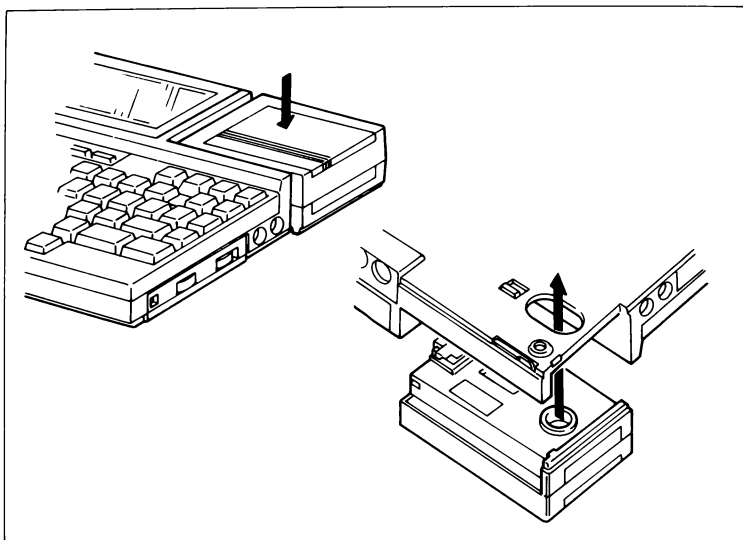
5. Push the cartridge in the direction indicated by the arrow to set it in place.
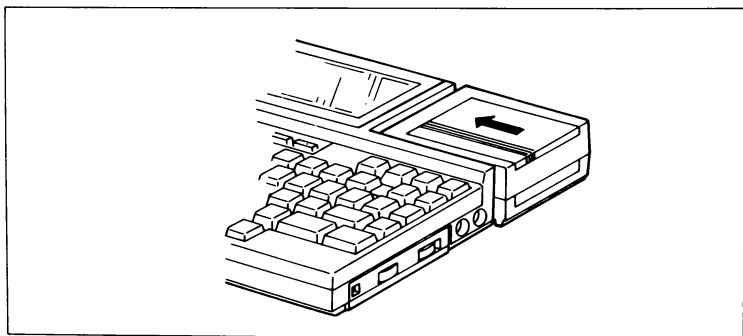
6. Return the cartridge lock switch to the LOCK position.

4.1.1 RAM cartridge

PX-4's RAM cartridge is an external storage device for storage and retrieval of data and programs. The cartridge is connected to PX-4 through the cartridge interface.

Data stored in the RAM cartridge is backed up by a lithium battery housed inside the cartridge, and thus is maintained even when the cartridge is removed from PX-4. Battery life is approximately 3 years. When the battery voltage becomes low (when the battery wears out), the LOW BATTERY lamp lights to indicate that it must be replaced.
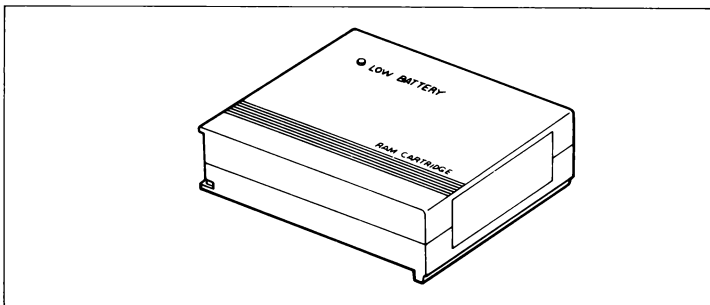
The RAM cartridge has a capacity of 16K bytes, and is accessed as drive I:. Before using the RAM cartridge, it must be formatted from the System Display. Ordinarily, formatting is a one-time process which does not need to be repeated as long as data inside the cartridge is not corrupted.

Formatting the RAM disk

To format the RAM cartridge, press CTRL + HELP to bring the System Display to the screen, then select "1 = RAM cartridge". After doing this, the screen will appear as shown below.

```
* SYSTEM DISPLAY *  05/05 (SAT) 14:41:59
<RAM   DISK> 026     KB   <ALRM> OFF
<USER  BIOS> 000×256 B   <AUTO> OFF
<MENU DRIVE> ABC          <MENU> ON

-Select or ESC to return.
   <RAM FORMAT>  1=no    2=yes
```

If "1" is pressed while this screen is displayed, the RAM cartridge is not formatted; if "2" is pressed, it is formatted.

4.1.2 ROM cartridge

PX-4's ROM cartridge is an external read-only storage device which is connected to PX-4 through the cartridge interface. Up to two ROM chips can be installed in the ROM cartridge; together with PX-4's ROM capsules, this makes it possible to install as many as four ROMs in PX-4. ROMs in the ROM cartridge are accessed as disk drives J: and K:.

ROMs with a capacity of up to 32K bytes can be installed in the ROM cartridge. Two 32K-byte ROMs can also be used as one device; in this case, the ROM cartridge is accessed as drive J: or K: and has a file capacity of 64K bytes.

Procedures for installing ROM chips in the ROM cartridge are as follows.

- Turn off the power switch and remove the ROM cartridge.
- Open the ROM cartridge by sliding its cover in the direction indicated in the figure below.
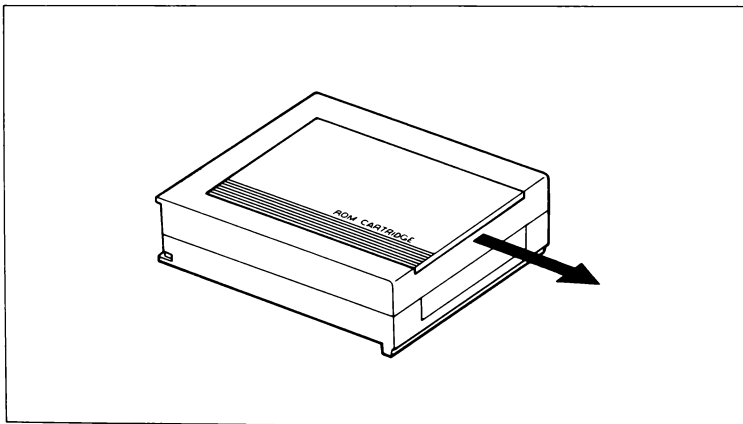
• Remove the ROM chips currently installed in the cartridge and replace them with others in the same manner as when replacing ROM capsules in the back of PX-4.
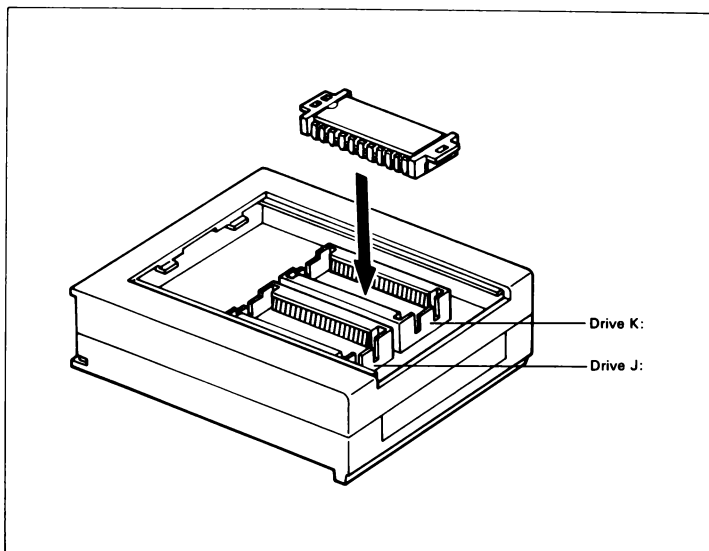
Drive K:

Drive J:

4.1.3 Microcassette drive

The microcassette drive makes it possible to use microcassette tape for storage of sequential files. Use the microcassette drive to store programs which are not used frequently or text data.

Since the standard CP/M operating system is designed for computers which use disk drives, it does not in principle support microcassette drive access. However, the functions of PX-4 CP/M have been extended to allow the microcassette drive to be accessed in much the same manner as a disk drive. Therefore, a directory similar to that used with disk files is written onto the tape by the operating system, and files on the tape are managed using this directory.

See 2.8 "Microcassette Handling" for details on microcassette drive operation.
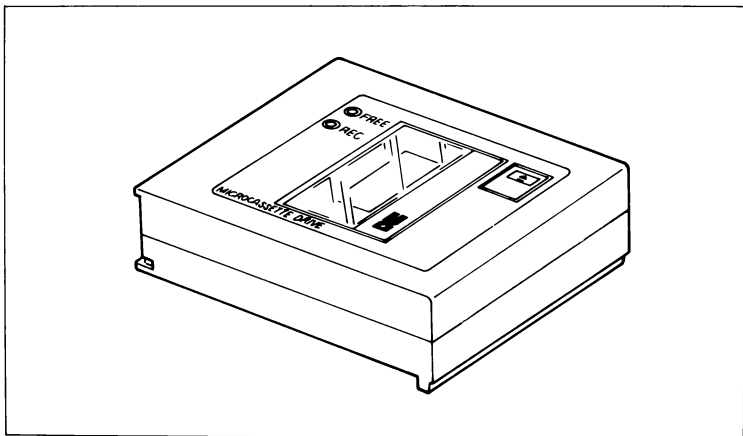
EJECT button: Press this button to remove tapes from the microcassette drive.

FREE This lamp indicates whether tape may be removed from the microcassette drive. Tape may be removed when the light is lit.

REC This lamp lights when data is being written to the tape in the microcassette drive.

4.1.4 Universal cartridge

The universal cartridge contains a general purpose circuit board and a connector for plugging the cartridge into PX-4's cartridge interface. Experienced users can prepare their own special-purpose cartridges by installing the appropriate components on this general purpose board.
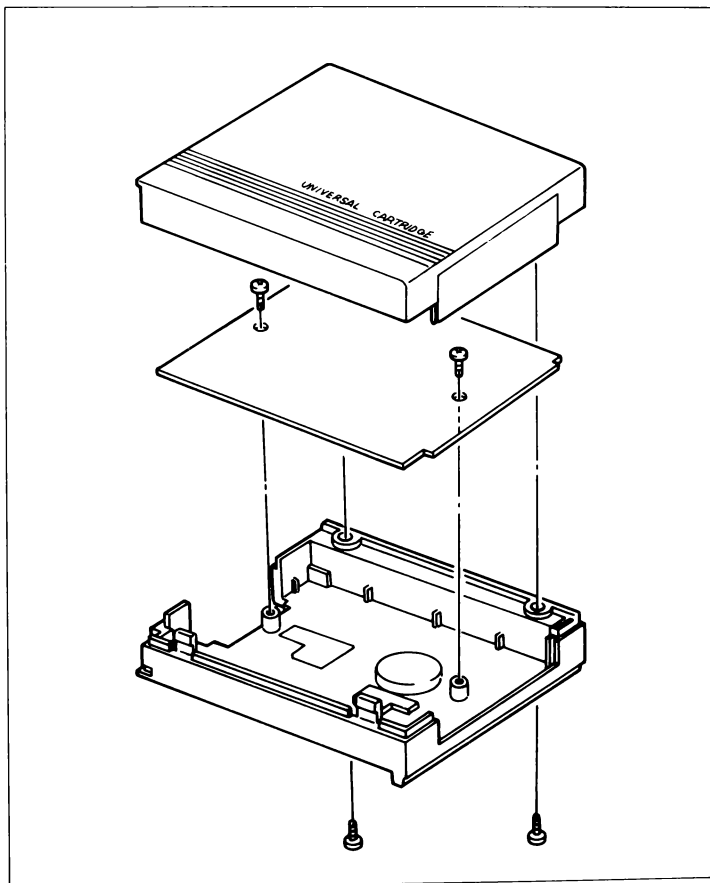
4.1.5 Digital multimeter cartridge

As its name implies, the digital multimeter cartridge is an option which makes it possible to use PX-4 to measure voltages and resistances. The cartridge converts analog input data into digital form to allow processing by PX-4.

The digital multimeter cartridge is powered by two AAA-size batteries. Install these batteries by opening the battery box. When measuring voltages, connect the test leads to the terminals marked COM and V; when measuring resistances, connect the leads to the terminals marked COM and Ω.

Battery box
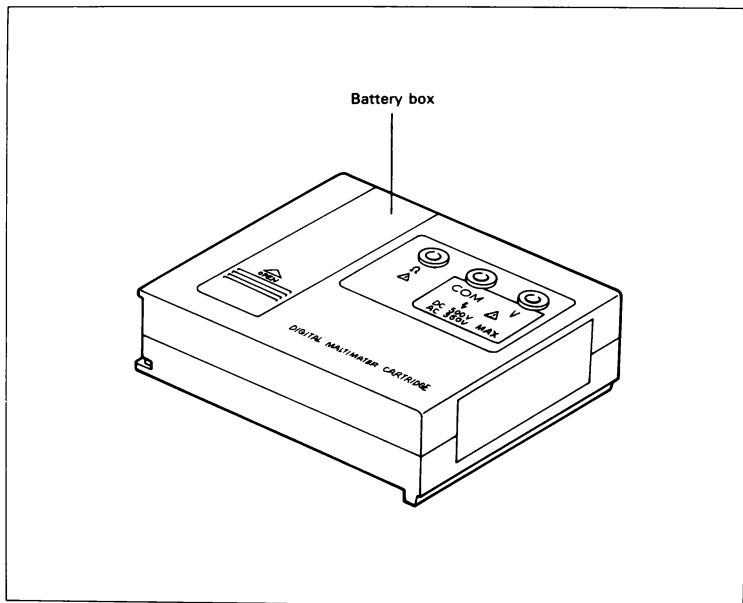
4.1.6 Cartridge Printer

The Cartridge Printer is available for PX-4 as follows.

Printer	Character format	Line width	Printing speed
M-164	6 × 8 dots	60 dots (40 characters)	2.5 sec/line*

* During continuous printing with two dots' space between each line.

The Cartridge Printer uses ordinary roll paper and is installed in PX-4's option cartridge slot. When the Cartridge Printer is used, change the DIP switch setting according to the table in section 4.3 Printers.

Detailed instructions for using the printer are provided in the Cartridge Printer Operating Manual.
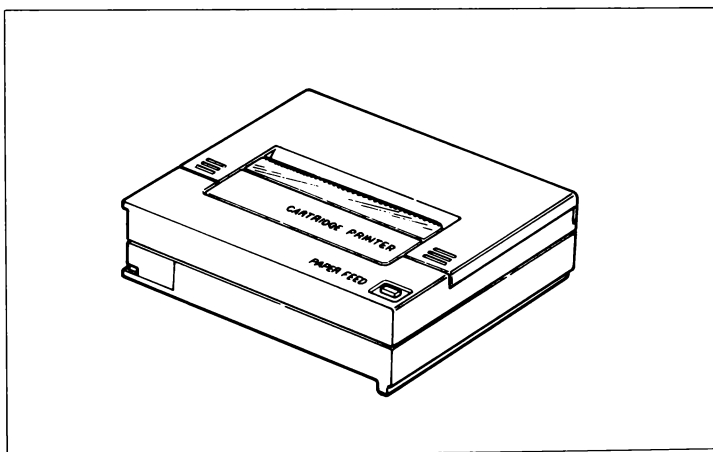
4.2 Keyboards

One of the most important features of PX-4 is that its standard keyboard can be removed and replaced with an optional item keyboard.

The keyboard is fastened to PX-4 by three screws as shown in the figure below.

Keyboard mounting screws
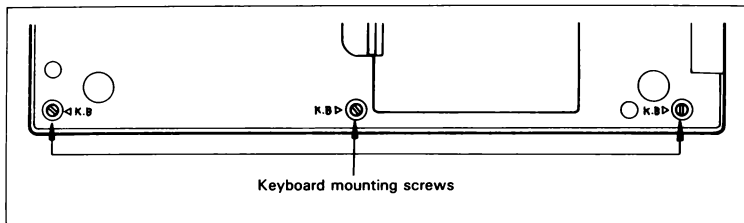
After removing the keyboard, handle it carefully to avoid damage.

PX-4

Keyboard
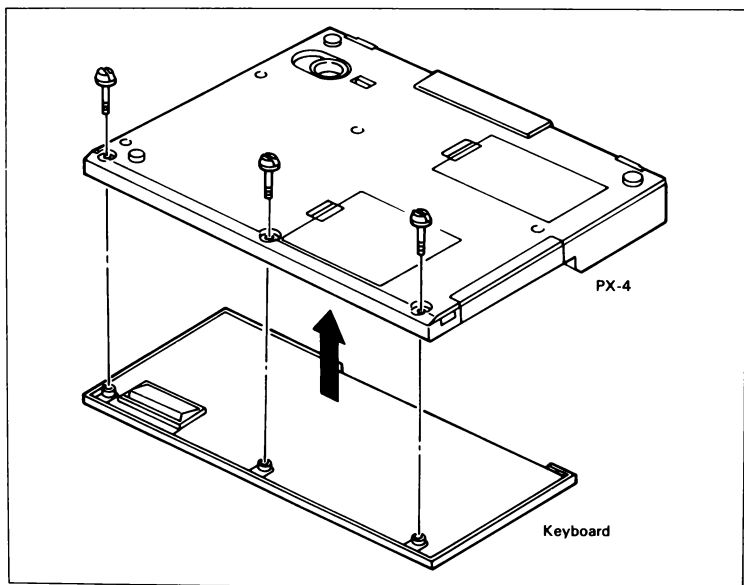
4.3 Printers

Any EPSON printer which is equipped with a parallel interface or an RS-232C interface can be used with PX-4. A list of printers which can be used is shown on the next page.

The printer is connected either to PX-4's parallel interface, or to its RS-232C or serial interface. The interface to which printer output is directed is determined by the settings of the DIP switch located inside the ROM capsule compartment. After changing the DIP switch settings, press the reset switch on the back side of PX-4 (not the reset switch inside the ROM capsule compartment).

DIP switch settings

DIP switch

DIP switch

The settings of DIP switch toggles 5 and 6 determine the interface to which printer output is directed.

Switch 5	Switch 6	Interface
OFF	OFF	Serial interface
OFF	ON	RS-232C interface
ON	OFF	Cartridge printer
ON	ON	Parallel interface
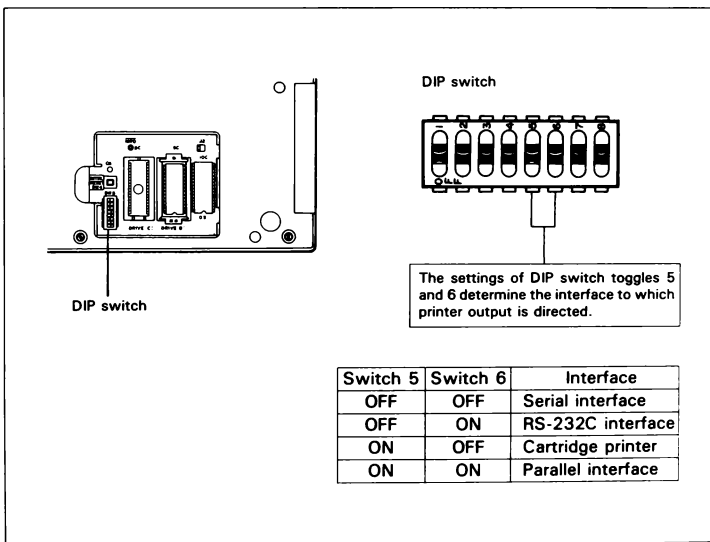
Printer	Interface	Cable	Remarks
MX-80 II,III MX-100 II,III RX-80 RX-100 FX-80 FX-100	Parallel	#731	If the printer is equipped with a serial interface board, it can also be connected to PX-4's the RS-232C or serial interface. In this case, use calbe set #725.
DX-100	Parallel	#731	Requires a printer adapter.
C-40	RS-232C Serial	#731	Built into printer
P-40	RS-232C Serial	#723	
P-80	RS-232C Serial	#723	

NOTE:
A special adapter is required in order to connect the DX-100 to PX-4.

4.4 Floppy Disk Unit

Floppy disk units which can be connected to PX-4 are the PF-10 and TF-15.
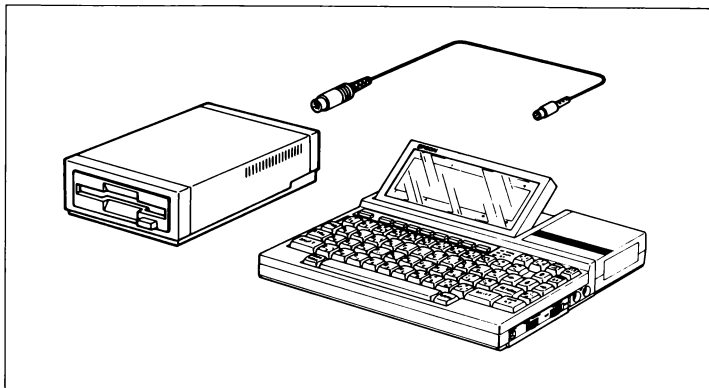
Disks handled by each of these units and cables used for connecting them to PX-4 are as follows.

    PF-10 .... 3.5-inch floppy disk × 1 (cable set #726)
    TF-15 .... 5.25-inch floppy disk × 1 or 2 (cable set
                                     #726)

Procedures for using the floppy disk units are described in the various floppy disk unit user's manuals.

4.5 Bar Code Reader

An optional bar code reader is available as below.

H00BR CODE JA (low resolution, 0.3 mm)

No bar code reader software support is provided with PX-4. If your application requires a bar code reader, consult your dealer for the appropriate bar code reader utility software.
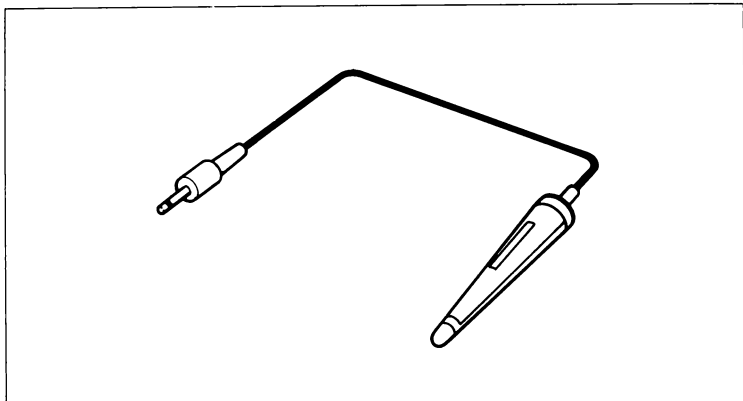
4.6 Acoustic Coupler

The EPSON CX-21 acoustic coupler makes it possible to use PX-4 for communication with other computers over a telephone line.

To use the CX-21, connect it to PX-4's RS-232C interface using cable set #724.
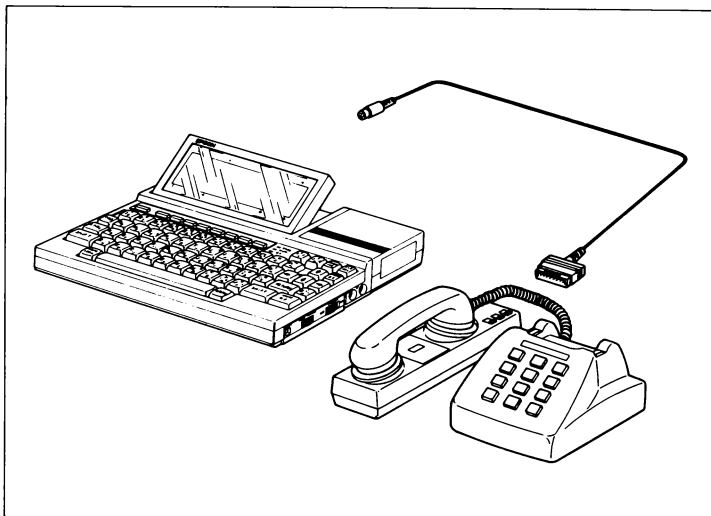
In addition to making it possible to communicate with other personal computers, the CX-21 allows PX-4 to be used as a remote terminal of any main frame computer system which can be accessed via the public telephone system. See the User's Manual for procedures for using the CX-21.

4.7 External RAM Disk

The size of PX-4's RAM disk can be expanded by installing the optional external RAM disk unit. This unit is accessed as drive A, and provides 128K bytes of random access storage capacity and up to 128K bytes of read only storage capacity. Read only memory is installed in the unit in the form of interchangeable capsules.

4.7.1 External RAM Disk power supply

Power for external RAM disk operation is supplied through the expansion port from PX-4. A NiCd battery pack must be used as PX-4's power supply whenever the external RAM disk unit is installed.

4.7.2 Backup power

The external RAM disk contains a built-in battery which backs up the contents of RAM when PX-4's main power is turned off. Memory backup becomes effective when the backup power ON/OFF switch is set to the ON position (see section 4.7.3 below); however, the contents of RAM are not maintained if the external RAM disk unit is disconnected from PX-4.

The backup battery is recharged together with PX-4's NiCd battery pack when the AC adapter is connected.

NOTE:
Ordinarily, RAM in PX-4 and that in the external RAM disk unit are backed up independently by their respective backup batteries. However, when the charge of either backup battery is reduced below a certain level, the remaining battery is used to maintain the contents of memory in both units. This assures that memory in both units will be maintained for the same amount of time.

4.7.3 DIP switch settings

Bit 1 of the DIP switch turns memory backup on or off, and bits 2 and 3 are set according to ROM capacity. Switch settings for different ROM capacities are as follows.

ROM capacity/type	SW2 setting	SW3 setting
8K bytes (27064)	K	A
16K bytes	K	A
32K bytes (270256)	K	A
64K bytes	1M	A
128K bytes (HN62301, etc.)	1M	A

Further information is given in the external RAM disk instructions and with instructions supplied with ROM capsules.
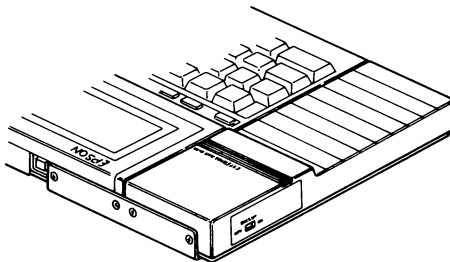
External RAM Disk

Chapter 5

UTILITY ROM

EPSON supplies many useful utility programs for PX-4, and some of these are available in ROM form. The utility ROM contains standard CP/M transient commands (PIP and STAT) and utilities which have been developed by EPSON for PX-4 (CONFIG, TERM and FILINK).

The utility ROM must be installed in a ROM capsule. See Section 2.10 for ROM capsule installation instructions.

5.1 CONFIG

The CONFIG program is used to set those system parameters which are not changed very often. It is complementary to the System Display, and the current values of some of the parameters changed by the CONFIG program are shown on the System Display. The CONFIG program can also be used to check the settings of parameters not shown on the System Display.

> **WARNING:**
> *Do not switch off PX-4 (either manually or by allowing the auto power-off function to operate) after changing the RAM disk or USER BIOS size without exiting from the CONFIG program. If PX-4 is switched off, the RAM disk contents could be destroyed and it might be necessary to re-initialise the system.*

When CONFIG is started, (either from the MENU or CP/M command line), the screen shows the following:

```
*** MAIN MENU ***        CONFIG V1.0
 Select alphanumeric or ESC to exit.
0=consecutive setting 6=disk drives
1=auto power off       7=RAMdisk,userBIOS
2=CP/M function key    8=communication
3=country              9=screen mode
4=cursor               A=printer(serial)
5=date & time
```

The CONFIG program is used in a almost the same way as the System Display, but it has 11 options. As with the System Display the [ESC] key is used to move back to the main menu and to exit. The [O] key is used to display option menus.

5.1.1 Auto power-off function

Press the [1] key from the main CONFIG menu to change the auto power-off time. The screen changes as follows.

```
*** AUTO POWER OFF ***
  Set time(1 to 255) in minutes or ESC
to exit. (0 disables auto power off)

  auto power off time ?

auto power off   : 5
```

The value shown next to the semi-colon on the 7th line is the current setting in minutes for the auto power-off time. This is the time which PX-4 waits before switching itself off if no key is pressed while an application program or the operating system is waiting for input. It is advisable to keep the time short; otherwise the battery will run down more quickly. The purpose of this function is to conserve the battery.

As can be seen from the display, the time can be set in one-minute increments (the maximum time is 255 minutes). The auto power-off function can also be switched off altogether by selecting option 0. After entering the desired time, press [RETURN]; the specified time is displayed on the 7th line. At this point, you can use the [ESC] key to return to the main CONFIG menu.

5.1.2 CP/M function key assignments

When option 2 is selected from the main CONFIG menu, the display changes to:

```
*** CP/M FUNCTION KEY ***
  Select key No.(PF10=0) or ESC to exit.█

PF1  dir          PF6  config█
PF2  type         PF7  submit
PF3  stat         PF8  term█
PF4  pip          PF9  filink█
PF5  basic        PF10 EPIC█
```

These are the strings which are assigned to the programmable function keys at the top of the keyboard. The screen above shows the default settings; i.e. the strings which are assigned when the system is initialised or the reset button is pressed.

Note that some of the strings terminate in the $\boxed{\text{CTRL}}$ - $\boxed{\text{M}}$ character, which is denoted by [M]. These strings have a carriage return ($\boxed{\text{CTRL}}$ - $\boxed{\text{M}}$) added to them because there is no possibility that any more characters will need to be typed following the string. For example, the $\boxed{\text{PF6}}$ key can be used to run the CONFIG program as follows: On the CP/M command line, type the name of the drive containing the CONFIG program (e.g. C:), then press the $\boxed{\text{PF6}}$ key. The word CONFIG appears, then a carriage return is also typed. In a few seconds, the CONFIG main menu appears on the screen.

$\boxed{\text{CTRL}}$ - $\boxed{\text{M}}$ is not added to all commands because some of them might require extending. For example, with DIR you might want to add the name of a drive other than the current one instead of first changing the logged-in drive. When the $\boxed{\text{PF1}}$ key is pressed, the letters "DIR" are printed, then PX-4 waits for further input. If you simply press the $\boxed{\text{RETURN}}$ key, the directory of the current drive will be printed. If you type "C:" and press the $\boxed{\text{RETURN}}$ key, the directory of drive C: will be displayed.

To change a function key string, press the number corresponding to that $\boxed{\text{PF}}$ (i.e., 1 for PF1, 2 for PF2, and so forth; remember that 0 is used for PF10). The following message is then displayed on the second line of the screen:

Terminate the function key string with HELP

The third line of the screen shows the name of the key whose function is to be changed with the cursor to the right of the name. Up to 15 characters can be assigned to each $\boxed{\text{PF}}$ key. If a control key command is to be added (e.g., a line feed, $\boxed{\text{CTRL}}$ - $\boxed{\text{J}}$), this can be added by pressing $\boxed{\text{CTRL}}$ and the appropriate alphabetic key. However, in the special case of the carriage return simply pressing the $\boxed{\text{RETURN}}$ key will add the characters [M] to denote the $\boxed{\text{CTRL}}$ - $\boxed{\text{M}}$ for the carriage return.

If you accidentally press an incorrect key, use the backspace key ($\boxed{\text{BS}}$) to erase it.

Since the $\boxed{\text{RETURN}}$ key can be used to enter a carriage return as ($\boxed{\text{CTRL}}$ - $\boxed{\text{M}}$), the $\boxed{\text{HELP}}$ key is used to terminate the string. After pressing the $\boxed{\text{HELP}}$ key, the $\boxed{\text{ESC}}$ key is used to return to CONFIG's main menu.

5.1.3 Changing the character set by country

The DIP switches are normally used to set the keyboard layout. Occasionally, it is useful to be able to temporarily change the characters but not the keyboard layout so that, for example, a word processor file written in French can be read on the screen with the correct characters. Pressing the $\boxed{3}$ key from CONFIG's main menu make it possible to select character sets of different countries for display. The menu shows:

```
*** COUNTRY ***
  Select number or ESC to exit.■

    COUNTRY              0=ASCII        5=Italy
                         1=Denmark      6=Japan
      : ASCII            2=England      7=Norway
                         3=France       8=Spain
                         4=Germany      9=Sweden
```

The country whose characters are displayed is changed by pressing the key corresponding to that country in the table on the right of the screen. The currently selected country is displayed on the 6th row on the left side of the screen. Pressing the $\boxed{6}$ key selects the ASCII character set.

5.1.4 Setting the display cursor

If option 4 is selected from CONFIG's main menu, the display changes to:

```
*** CURSOR ***
  Select number or ESC to exit.■

  cursor tracking : vertical  1=on      2=off
                                 3=vertical
  cursor display  : on        4=on      5=off
  cursor type     : ■         6=■       7=■
                                 8=_      9=_
```

The left side of the screen shows the current status of parameters which can be altered by this section of the CONFIG program. The right part of the screen shows which keys will change these parameters, parameter settings are altered simply by pressing the appropriate key. For example, if the ⑨ key is pressed, the left hand side of the screen will show "__" to indicate that type of cursor is selected.

Keys ① and ② switch the tracking mode on and off. In the tracking mode, the cursor follows the window as it moves through the virtual screen. In the non-tracking mode, the window is locked to a particular part of the virtual screen and the cursor (the position where characters are input or where PX-4 displays the next character) moves through the virtual screen; thus, the cursor disappears when it moves outside the window.

5.1.5 Setting the date and time

The date and time can be set by selecting option 5 of CONFIG's main menu. The time is entered the moment the RETURN key is pressed. When the date is input, the day of the week is calculated automatically.

When option 5 is selected from CONFIG's main menu, the display changes to:

```
*** DATE & TIME ***
  Select date and time or ESC to exit.

Date as MM/DD/YY ?

        Date    :    01/16/00   (TUE)
        Time    :    21:37:34
```

At this point, PX-4 is waiting for the date to be input; however, simply pressing the RETURN key will switch it to time input. To input the date, type the month, day and the last two digits of the year, separating each item from the following one with a slash ("/"). If you make any mistakes, use the BS key to back up and erase. Items consisting of a single digit need not be preceded by a zero; however, data must be entered for all these items (month, day, and year) or an error will be detected and the input line cleared. The data is entered when the RETURN key is pressed. If an illegal date is entered (e.g., if the specified day of the month is greater than the number of days in that month), the input line is cleared to allow the date to be entered again.

Change the time by inputting the hour, minute and second, with a colon be-tween each. If you make any mistakes, use the [BS] key to back up and correct. When the desired time has been entered, press the [RETURN] key to enter it into the computer's memory. PX-4 starts updating the time when the [RETURN] key is pressed.

When a date has been entered, the display changes to time input.

Press the [ESC] key at any time to return to CONFIG's main menu.

5.1.6 Disk drive assignments

Selecting option 6 from CONFIG's main menu cause's the screen to change as follows:

```
*** DISK DRIVES ***
  Select disk name or  ESC to exit.█
        Logical              Physical
A:RAMdisk  F:FDD3      0=RAMdisk  5=FDD3
B:ROMcps1  G:FDD4      1=ROMcps1  6=FDD4
C:ROMcps2  I:RAMcrt    2=ROMcps2  7=RAMcrt
D:FDD1     J:ROMcrt1   3=FDD1     8=ROMcrt1
E:FDD2     K:ROMcrt2   4=FDD2     9=ROMcrt2
```

First, select a logical drive name by pressing [A] to [K], but not [H]. Other keys other than [A] to [K], (except [H]) and [ESC] are ignored. For example, pressing [A] causes the screen to change as follows:

```
*** DISK DRIVES ***
  Select disk number.  A:
        Logical              Physical
A:RAMdisk  F:FDD3      0=RAMdisk  5=FDD3
B:ROMcps1  G:FDD4      1=ROMcps1  6=FDD4
C:ROMcps2  I:RAMcrt    2=ROMcps2  7=RAMcrt
D:FDD1     J:ROMcrt1   3=FDD1     8=ROMcrt1
E:FDD2     K:ROMcrt2   4=FDD2     9=ROMcrt2
```

Select the physical drive which is to be assigned to the first logical drive select-ed by typing a number 0 to 9. Keys other than 0 to 9 are ignored.

The microcassette drive is always drive H:, and thus is not shown in this menu. The terms FDD1, FDD2, FDD3 and FDD4 refer to external Floppy Disk Drives which can be connected to PX-4 via the serial interface.

5.1.7 RAM disk & user BIOS

This option is used to change the amount of memory set aside for the RAM disk and user BIOS areas.

When option 7 is selected from CONFIG's main menu, the screen changes as follows:

```
*** RAM DISK & USER BIOS ***
  Set parameter or ESC to exit.
  RAM disk size ?

RAM disk size          :     26K bytes
Max. RAM disk size is        35K bytes
user BIOS size         :      0  pages
Max. user BIOS size is       38  pages
```

The current RAM disk size is shown on the fifth line, and can be changed by typing 0 or a number from 2 to 35. If the size is reduced, any files presently in the RAM disk will be destroyed. However, files are not destroyed if the RAM disk size is increased. The RAM disk size typed is temporarily stored in memory when the [RETURN] key is pressed, but the input line is merely cleared if an illegal value has been entered. If the value enterd is less than the current value, the following message and a blinking cursor are displayed on the fourth line of the screen.

RAM disk will be destroyed (Y/N) ?

If the [Y] key is pressed, the new RAM disk size becomes effective and existing RAM disk files are destroyed. If the [N] key is pressed, the fourth line is cleared and the "RAM disk size ?" message is displayed again.

When the [RETURN] key is pressed, the third line of the screen changes as shown below.

```
*** RAM DISK & USER BIOS ***
  Set parameter or ESC to exit.
  user BIOS size(256 bytes/page) ? ■

RAM disk size          :     26K bytes
Max. RAM disk size is        35K bytes
user BIOS size         :      0  pages
Max. user BIOS size is       38  pages
```

The current user BIOS size is shown on the seventh line, and can be changed by typing in a new size in 256-byte pages. If the value input is less than the current value, the following message is displayed on the fourth line.

hook initialization (Y/N) ?

If the [Y] key is typed, all hooks are initialized and the new BIOS size is set. If the [N] key is pressed, the message disappears and CONFIG waits for you to type in some other value.

If an intelligent RAM disk is connected, its size cannot be extended using part of PX-4's main memory. In this case, the screen appears as shown below when option 7 is chosen from CONFIG's main menu, and only the size of the user BIOS area can be changed.

```
*** RAM DISK & USER BIOS ***
  Set parameter or ESC to exit.
  user BIOS size(256 bytes/page) ?

RAM disk size         :  128K bytes
<<An external RAM disk is connected>>
user BIOS size        :    6 pages
Max. user BIOS size is 142 pages
```

The [ESC] key can then be used to return to CONFIG's main menu.

⚠ *WARNING:*
Do not switch off PX-4 (either manually or by allowing the auto power-off function to operate) after changing the RAM disk size without exiting from the CONFIG program. If PX-4 is switched off, the RAM disk may be destroyed and it may also be necessary to re-initialise the system.

5.1.8 Communications

Option 8 on CONFIG's main menu is used to set communications parameters.

The RS-232C interface or direct modem is used to transmit data to and from PX-4. For example, if a text file has been written on PX-4 and it needs to be transferred to desk top computer such as the EPSON QX-10, the file can be sent to the other computer using the TERM or FILINK program in the CP/M UTILITY ROM. The two computers can either be connected directly by cable, or through a telephone line.

When option 8 is chosen from CONFIG's main menu the screen changes to display:

```
*** COMMUNICATION ***
  Select alphanumeric or ESC to exit.▓

bit rate    1=38400   6=1200   B=110
 : 4800     2=19200   7=600    C=75/1200
            3=9600    8=300    D=1200/75
            4=4800    9=200       (TX/RX)
            5=2400    A=150
```

The bit rate (number of bits per second or baud rate) currently set is shown on the fifth line. It can be changed to various settings using keys [1] to [9] and [A] to [D] . Keys [1] to [9], [A] and [B] set the same bit rates in both directions (send and receive). The [C] and [D] keys set different bit rates for transmitting and receiving. The [C] key sets 75 bps for send and 1200 bps for receive, and the [D] key sets 1200 bps for send and 75 bps for receive.

Pressing the [ESC] key returns to CONFIG's main menu. Pressing the [RETURN] changes the screen as follows.

```
*** COMMUNICATION ***
  Select alphanumeric or ESC to exit.

data bits: 8        1=7      2=8
parity   : none     3=none 4=odd  5=even
stop bits: 2        6=1      7=2
xon/xoff : disable 8=disable 9=enable
si/so    : disable A=disable B=enable
```

The number of data bits (i.e., the number of bits per character) is shown on the fourth line and can be changed using the [1] and [2] keys.

The type of parity used is shown on the fifth line and can be changed using the [3], [4] and [5] keys.

The number of stop bits is shown on the sixth line and can be changed using the [6] and [7] keys.

The Xon/Xoff control setting is shown on the seventh line and can be changed using the [8] and [9] keys.

The si/so control setting is shown on the eighth line and can be changed using the [A] and [B] keys.

After all parameters have been set or checked, the [ESC] key returns PX-4 to CONFIG's main menu.

5.1.9 Screen

This option is used to change the screen configuration. When option 9 is selected from CONFIG's main menu, the screen changes as follows, with a blinking cursor on the fourth line.

```
*** SCREEN ***
 Set screen parameter or ESC to exit.

 virtual screen size(holizontal) ? ▉

virtual screen size(40,80x8-50): 80 x 25
holizontal scroll step(20,40)  : 20
vertical scroll step(1-8)      : 1
```

The current virtual screen size is shown on the sixth line. You can type in 40 or 80 as the horizontal size of the virtual screen when the "virtual screen size (horizontal)?" prompt is displayed. If a number other than 40 or 80 is typed, the input line is cleared when the [RETURN] key is pressed, but nothing else changes. If a valid number has been entered, the message on the fourth line changes to "virtual screen size (vertical)?".

Now you can type in as the vertical size of the virtual screen as a number from 8 to 50. If the value typed is outside of this range, the input line is cleared when the [RETURN] key is pressed, but nothing else changes.

If a valid number has been entered, the prompt on line 4 changes as follows when the [RETURN] key is pressed.

horizontal scroll step ?

You can type in 20 or 40 as the horizontal scroll step. If any other number is typed, the input line is cleared when [RETURN] is pressed, but nothing else changes.

If a valid number has been entered, the prompt on line 4 changes as follows when [RETURN] is pressed.

vertical scroll step ?

Enter the vertical scroll step as a number from 1 to 8. If any other number is typed, the input line is cleared when [RETURN] is pressed, but nothing else changes.

After changing the screen configuration, press the [ESC] key to return to CONFIG's main menu.

5.1.10 Serial printer parameters

A printer with a RS-232C interface can be connected to PX-4's serial or RS-232C connector. (The connector used for printer output is determined by the setting of bits 5 and 6 of the DIP switch in the ROM capsule compartment. See Chapter 4 of the PX-4 User's Manual for details.) The serial interface parameters for connecting such a printer can be set by selecting option A from CONFIG's main menu. When the [A] key is pressed, the screen changes to:

```
*** PRINTER (serial) ***
  Select alphanumeric or ESC to exit.

bit rate    1=19200    5=1200    9=150
 : 4800     2=9600     6=600     A=110
            3=4800     7=300
            4=2400     8=200
```

The current bit rate setting is shown on the fifth line and can be changed using keys ①to⑨ and key Ⓐ. Keys other than these keys or ⎡ESC⎤ and ⎡RETURN⎤ are ignored. Pressing the ⎡ESC⎤ key returns to CONFIG's main menu. If the ⎡RETURN⎤ key is pressed, the screen changes to:

```
*** PRINTER (serial) ***
 Select alphanumeric or ESC to exit.

data bits : 8      1=7      2=8
Parity    : none   3=none   4=odd   5=even
stop bits : 2      6=1      7=2
```

The current "data bits" setting is shown on the fourth line and can be changed using keys ① and ②.

The current "parity setting" is shown on the fifth line and can be changed using keys ③, ④ and ⑤.

The current "stop bit setting" is shown on the sixth line and can be changed using keys ⑥ and ⑦.

Pressing the ⎡ESC⎤ key returns to CONFIG's main menu. If the ⎡RETURN⎤ key is pressed, the first screen (the bit rate selection screen) is displayed again. Keys other than the above are ignored.

5.2 FILINK

The FILINK program transfers files between PX-4 and another computer (such as another PX-4, QX-10, etc.) through the RS-232C communication line.

Software which support the FILINK communication protocol must be executed on the other computer to transfer files. Configurations which support the protocol are as follows.

Computer	Software
PX-8	FILINK.COM T and C commands of WS.COM /Join, Send and /Join, Receive commands of SC.COM
PX-4	FILINK.COM
QX-10	FILINK.COM

EPSON supplies optional cables which can be used to connect PX-4 to other EPSON computers as follows.

Other device	Cable
PX-8	#726
QX-10 QX-20	#725
.CX-21	#724
PX-4	#726

5.2.1 Using FILINK

The FILINK program is loaded by keying in the drive name and FILINK, then pressing the RETURN key.

A > B:FILINK

The following message is then displayed.

FILINK © Copyright 1984 by EPSON V1.0
A file transfer via RS-232C port.

The RS-232C status is:
rate = 4800   bits = 8   stop = 2   parity = NONE

Use CONFIG.COM program to change
the RS-232C status.

The current RS-232C settings are displayed in the fifth line of the initial screen. However, these settings cannot be changed from the FILINK program. Therefore, use the CONFIG program to establish appropriate RS-232C settings before executing FILINK.
Press any key; the following message is then displayed.

Press ESC to restart, STOP to exit
from FILINK or CTRL/STOP to abort.
Send or Receive (S/R) ?

If files are to be sent, enter S; if files are to be received, enter R.

If Send is selected, FILINK asks what file is to be sent. Respond by entering the drive name (if the file is in a drive other than the current drive), file name, and extension. Ambiguous file names can be specified using wildcard characters (∗ and ?). If the other computer is ready, FILINK starts sending the specified file when the RETURN key is pressed. An example is shown below.

Send or Receive (S/R) ? s
Enter file name ∗ com [RETURN]

DATA1 .COM
   Sending................................

```
DATA2  .COM
    Sending ................................
DATA3  .COM
    Sending ................................
DATA4  .COM
    Sending ................................
DATA5  .COM
    Sending ................................
Done
eXit or Continue (X/C) ?
```

The name of each file is displayed as it is sent. Periods displayed following the file names each indicate output of 128 bytes of data (these periods are also displayed following file names when files are received).

The message "eXit or Continue (X/C) ?" is displayed after file output (or input) has been completed to ask whether FILINK operation is to be continued or ended. If operation is to be ended, input X to return to the system. If it is to be continued, input C; operation then resumes with the "Send or Receive (S/R) ?" prompt.

On the receiving side, the screen appears as shown in the example below when ambiguous file names are used to receive files.

```
Send or Receive (S/R) ? r
Enter file name * COM [RETURN]
DATA1  .COM → DATA1  .ABC
    Receiving ............................
DATA2  .COM → DATA2  .ABC
    Receiving ............................
DATA3  .COM → DATA3  .ABC
    Receiving ............................
DATA1  .COM → DATA1  .ABC
    Receiving ............................
DATA4  .COM → DATA4  .ABC
    Receiving ............................
Done
eXit or Continue (X/C) ?
```

When files are received without specifying any file name, they are stored on the disk under the file name which is received from the sending side. An example follows.

```
Send or Receive (S/R) ? r
Enter file name
DATA1  .COM → DATA1  .COM
     Receiving ...............................
DATA2  .COM → DATA2  .COM
     Receiving ...............................
DATA3  .COM → DATA3  .COM
     Receiving ...............................
DATA1  .COM → DATA1  .COM
     Receiving ...............................
DATA4  .COM → DATA4  .COM
     Receiving ...............................
Done
eXit or Continue (X/C) ?
```

If a file with the same name is already present on the disk (on the receiving side), FILINK displays the following message to ask whether the existing file is to be overwritten.

```
Overwrite (Y/N) ?
```

If Y is input in response to this message, the existing file is overwritten with the file which is received; if N is input, a message prompting for input of a different file name is displayed. This file name is only effective for one file, regardless of whether it is specified using wildcard characters. This is illustrated in the example below.

```
Send or Receive (S/R) ? r
Enter file name
FILE2  .DAT → FILE2  .DAT
Overwrite (Y/N) ?   Y
     Receiving ...............................
FILE3  .DAT → FILE3  .DAT
Overwrite (Y/N) ?   N
Enter file name   ????6.DAT
FILE3  .DAT → FILE6  .DAT
     Receiving ...............................
```

5.2.2 Functions of special keys

The following keys perform special functions.

(1) ESC
Pressing the [ESC] key while the program is waiting to receive files starts program execution over from its beginning.

(2) STOP
Pressing the [STOP] key while the program is waiting to receive files interrupts processing and terminates the program.

(3) CTRL/STOP
Pressing the [CTRL] and [STOP] keys together while the program is waiting to receive files or is sending files interrupts processing and aborts program execution.

5.2.3 Errors

When an error occurs during FILINK operation or a condition exists which requires a user decision, it is detected by the program and a message is displayed. Messages displayed for each error/condition and procedures for handling them are as follows.

(1) File not found
Cause: The specified output file does not exist.
Handling: Respecify using the correct file name.

(2) No file name specified
Cause: An attempt was made to send without specifying a file name.
Handling: Specify the file name.

(3) Bad file descriptor
Cause: The file name specified does not conform to the rules for specifying file descriptors.
Handling: Correctly specify the file name.

(4) Drive select error
Cause: A drive name other than A: to K: was specified.
Handling: Specify a drive name from A: to K:.

(5) Overwrite (Y/N) ?

Cause: This message is issued on the receiving side when a file with the specified name already exists.

Handling: Type in Y or N. If Y is input, the existing file is overwritten; if N is input, FILINK prompts for specification of another file name.

(6) Communication error

    Press ESC to restart, STOP to exit from FILINK.

Cause: A communication error (framing or overflow error) occurred, or the same communication parameters (word length, parity, baud rate, etc.) are not set on the sending and receiving computers.

Handling: When this message appears, keys other than the following are ignored and the file being transferred must be resent from the beginning.

        |ESC| .... Restarts the program.
        |STOP| .... Ends the program.

        When this message is displayed because the communication parameters have not been correctly set, end FILINK execution and respecify the RS-232C settings with the CONFIG command.

(7) Directory full

    Press ESC to restart, STOP to exit FILINK.

Cause: The directory space on the destination disk is full.

Handling: When this message appears, keys other than the following are ignored.

        |ESC| .... Restarts the program.
        |STOP| .... Ends the program.

        Change to another disk, then start the FILINK program again. The file being transferred when the error occurred must be resent from the beginning.

(8) Disk full

    Press ESC to restart, STOP to exit FILINK.

Cause: There is no free space left on the destination disk.

Handling: When this message appears, keys other than the following are ignored.

| ESC | .... Restarts the program. |
| STOP | .... Ends the program. |

Change to another disk, then start the FILINK program again.

(9) Close error

Cause: An error occurred while a file was being closed.

Handling: Change to another disk, then start the FILINK program again.

(10) Sender is not ready

Cause: The sending computer did not become ready to send within 10 seconds of the time the receiving side began waiting for file transmission. Or, the RS-232C cable is not connected to the receiving computer.

Handling: Make sure that the sending computer is ready to send and that the RS-232C cable is connected, then continue operation.

(11) Receiver is not ready

Cause: The receiving computer did not become ready to receive within 10 seconds of the time the sending computer became ready to send.

Handling: Make sure that the receiving computer is ready to receive, then continue operation.

(12) RS-232C is not ready

Cause: The RS-232C cable is not connected to the sending computer.

Handling: Make sure that the RS-232C cable is connected, then continue operation.

Notes Concerning Use

(1) File names on the receiving side
   - When file names are specified on the receiving side:
     - (a) When an unambiguous file name is specified on the receiving side (when wildcard characters are not used in the file specification), the file received is written to disk under that file name.
     - (b) When an ambiguous file name is specified on the receiving side (when wildcard characters are included in the file name specification), the name under which the file is written to the disk combines the unambiguous portion of the file name specified with those portions of the file name received which correspond to the wildcard characters. Spaces in the file name are padded with dollar signs ($).

   - When no file name is specified on the receiving side, the file name received is used as is. Spaces in the file name are not padded with dollar signs.

(2) Setting up the data link between the sending and receiving computers

   If the sending computer becomes ready before the receiving computer, factors related to signal timing make it more likely that communication errors (framing errors) will occur at lower baud rates (1200 bps or less). To avoid this, you should make the receiving computer ready first.

(3) Any file in the destination drive whose extension is $$$ will be deleted unconditionally if it has the same file name as that under which a file is being received.

(4) If file reception is interrupted by pressing [CTRL] + [STOP], the file being written is deleted from the disk. However, if file reception is interrupted because the disk becomes full, the file is closed and remains on the disk; in this case, the file extension is $$$.

(5) Errors occurring during file transfer

   Check data is inserted into file names and data transferred to increase communication reliability. If any data error is detected during file transfer, related characters are displayed on the screen, then FILINK resends the packet in which the error occurred. This continues until data transfer has been successfully completed.

5.3 PIP

The PIP program is used to copy files between peripherals, e.g. from disk to disk, from a disk to a printer etc. The name comes from the initial letters of the words Peripheral Interchange Program.

PIP can be used with wildcard characters to transfer all types of files. It can also be used to perform other valuable functions such as:

- Remove part of a file (either at the beginning, end or in the middle of a file).
- Convert all characters to upper case or lower case
- Join a number of files together
- Make a backup file under a different name
- Add sequential numbers to each logical line of text
- Reform the page length of a text file

There are two ways PIP can be used.

1) When only a single operation is required, PIP can be used by following the PIP command with a command string which designates the operation you wish to carry out. On completion of the operation the CP/M prompt is returned or the MENU display if it is switched on. When using PIP from the MENU, the command string can be typed on the MENU command line after selecting PIP.

2) When a number of operations are to be performed, the PIP program can be loaded into memory. The CP/M prompt (A>, B>, etc.) is replaced by a PIP prompt (an asterisk). The use of PIP in this manner is essentially the same as when only one operation is required. This method must be used in certain cases; e.g., when starting or ending file transfer using lowercase. When PIP is chosen from the MENU, the PIP screen will clear and the PIP asterisk prompt will appear unless an additional command string is entered.

Pressing the $\boxed{\text{RETURN}}$ key, the $\boxed{\text{STOP}}$ key or $\boxed{\text{CTRL}}$ - $\boxed{\text{C}}$ returns display to the MENU screen or the CP/M system prompt, whichever is set.

When using PIP, you must specify a source device/file and a destination device/file. The source device/file is always specified last.

5.3.1 Copying a file from drive to drive

Any file excepts a system file can be copied from one disk to another as follows:

C > PIP H: = A:INFO.DAT

This copies the file DEMO.DAT from drive A: to drive H: then returns to the system prompt. The file is recorded under the same filename on the new drive. The filename can be changed, for example:

C > PIP H:NEWNAME.DAT = A:INFO.DAT

By using this option to copy a file to the same drive, you can make a backup copy of a file under a different name.

Various options can be added to the end of the PIP command string. For example specifying the [V] option causes the file to be verified as it is copied:

C > PIP H: = A:INFO.DAT[V]

5.3.2 Copying a file from disk to printer

This has almost the same effect as pressing CTRL - P then asking the computer to TYPE a file:

C > PIP LST: = A:LETTER.TXT

The file is printed character by character, and words which come at the end of a line are likely to be split in the middle of the word.

A refinement of this command is to add the option [Pn]; this causes the printer will execute a form feed every n lines. This prevents lines from being printed on the perforations. For example:

C > PIP LST: = A:INFO.DAT[P60]

will force a form feed every 60 lines giving the same effect as a one-inch skip-over on paper which takes 60 lines.

An additional option makes it possible to echo the file to the screen at the same time as it is printed. This is achieved using the [E] option:

C > PIP LST: = A:INFO.DAT[E]

If both options are required, the command would be:

C > PIP LST: = A:INFO.DAT[P60E]

5.3.3 Copying a file from disk to screen

The use of this command will have the same effect as the [E] option when copying to any other device. It is also the same as using TYPE command. The format is:

C > PIP CON: = A:MEMO.DOC

One of the options that can be specified here to good effect is [N] or [N2]. This causes line number to be added at the beginning of each line in the form 01 if [N] is specified and 000001 if [N2] is specified:

C > PIP CON: = A:MEMO.DOC[N2]

In addition, all lower case characters can be converted to upper case, and vice versa, using the [U] and [L] options:

A > PIP CON: = A:MEMO.DOC[N2U]

will give

000001 THIS IS A LINE OF TEXT
000002 HAVE A NICE DAY

and

A > PIP CON: = A:MEMO.DOC[NL]

will give

01 this is a line of text
02 have a nice day

5.3.4 Copying a file to an external device

Files can be copied to external devices such as printers, disk drives and other computers by specifying the relevant output port as the destination. For instance:

A > PIP TTY: = A:DEMO.BAS

will copy the file to a printer or any other device connected to the high-speed serial output port.

5.3.5 Optional parameters available with PIP

There are nineteen options which can be used with the PIP command, including those which have been mentioned already:

1. Block mode transfer

Format   **[B]**

This option causes the data to be transferred in blocks. (This option is provided for use with devices such as paper tape readers, and is ordinarily not used.)

Example   **A > PIP TEST.FIL = RDR:[B]**

2. Echo to screen

Format   **[E]**

This option causes the screen to display all the data transferred so that you can see what is being copied.

Example   **A > PIP LST: = TEST.FIL[E]**

It is advisable to user the [V] entry (i.e., to verify the file) when using the [E] option.

3. Form feed insertion

Format   **[Pn]**

This makes it possible to force a form feed (ASCII code 12 or hex 0C) every n lines. It is particularly useful when sending files to the

printer, because it allows the perforations in continuous forms to be skipped to improve legibility. If n is omitted or given as 1, PIP assumes a form feed is required every 60 lines (that is, the default setting). If your paper length is 66 lines per page, use the parameter as follows:

A > PIP LST: = REPORT.TXT[P66]

Remember that this code is also the 'clear screen' code, so it is advisable to take care when using this option. If this option is used with the [F] parameter, the [F] should come first:

A > PIP LST: = REPORT.TXT[FP66]

4. Form feed suppression

Format **[F]**

This is most useful when using PIP with a printer. It suppresses the form feed character (ASCII code 12 or hex 0C) which otherwise would cause the printer to feed a sheet through when it encounters the code.

Example **A > PIP TTY: = TEXT.DOC[F]**

In conjunction with [Pn] it can be used to change the page lengths by copying a file, removing previously added form feeds and adding them at a different place.

5. Hex format

Format **[H]**

When this option is specified, data transferred is checked to ensure it is in Intel HEX format. If there is a discrepancy, transfer is terminated.

Example **A > PIP DEMO2.HEX = DEMO1.HEX[H]**

6. Ignore NULL records

Format   [I]

This can be used as an alternative to [H] - it causes PIP to ignore NULL records (hex 00) and ensures the data is in Intel HEX format. It is therefore an extension of the [H] option.

Example   A > PIP DEMO2.HEX = DEMO1.HEX[I]

7. Lower case conversion

Format   [L]

This option converts all upper case characters to lower case as they are transferred.

Example   A > PIP LST: = C:LITTLE.DOC[L]

8. Numbering lines

Format   [N]
            [N2]

When sending programs to another device it may be useful to have the lines numbered. PIP regards a line as a series of characters terminated by a carriage return (ASCII code 13 or 0D hex). Specifying [N] will begin the file at column 9 of the screen and display the number of the line with a colon(:) in the seventh position followed by a space. For example

C > PIP A: = D:TEST.DOC[N]

```
  1: This is line one
  2: This is line two
        *
 10: This is line ten
        *
100: This is line one hundred
```

Specifying [N2] fills all leading spaces with a zero and replaces the colon with a space.

C > PIP A: = D:TEST.DOC[N2]

```
000001   This is line one
000002   This is line two
         *
000010   This is line ten
         *
000100   This is line one hundred
```

9. Object file transfer

Format   **[O]**

Normally PIP can only copy standard ASCII or HEX files, but using this option allows it to transfer other types of files. Its effect is to ignore the physical end-of-file code a CTRL-Z (ASCII 26 or 1A hex) wherever it occurs in the object file, because in this context it will not be signalling the end of the file.

Example   **A > PIP B: = OBJECT.FILE[O]**

It is not necessary to use this optional parameter with a COM file, because PIP adds it automatically. However, when PIP is used with other machine code or object files which do not have the file extension COM the [O] parameter MUST be used.

10. Read system files

Format   **[R]**

This option makes it possible to read and copy system files, that is, files which do not appear in the directory and those with a filetype of SYS. It automatically sets the [W] option.

Example   **A > PIP B: = A:.OSTAB.SYS[R]**

11. Stop copying at specified string

Format   [Qstring^Z]

(^Z indicates CTRL-Z, which is entered by holding down the [CTRL] key and pressing [Z].)

If you only want to transfer part of a file, this option causes PIP to stop file transfer when it finds the specified string. Only text preceding the string is copied.

Example   A > PIP LST: = B:REPORT.DOC[QTHE END^Z]

If you want to search for a string containing lower case characters, start PIP and type the command string following the PIP prompt (*). (CP/M converts everything typed on the command line into uppercase, so lowercase strings cannot be entered from the CP/M command line.)

Example   * LST: = B:REPORT.DOC[QThe End^Z]

The [Q] option can be used with the [S] option to copy a section from the middle of a file.

12. Start copying at a specified string

Format   [Sstring^Z]

This behaves in much the same way as the [Qstring^Z] option, except that it starts copying from the end of the specified string. The same conditions apply as with the [Q] option if you want to detect lowercase characters.

Example   A > PIP CHAPTER1.DOC = CHAPTER1.DOC
[SINTRODUCTION^Z]

The [S] and [Q] options can be used together if you want to copy a section from the middle of a file.

Example   * CHAPTER1.DOC = CHAPTER2.DOC
[SIntroduction^ZQlast.^Z]

13. Tab settings

Format   **[Tn]**

Tab settings in the destination file can be changed from those of the original with this option. The number given by n puts tabs settings at columns n, 2n, 3n, and so forth. For instance, [T9] puts tabs settings at columns 9, 19, 29, 39, etc. These settings are used wherever PIP comes across a TAB character in the file it is copying. The TAB characters is CTRL-I (ASCII code 9).

If the word processor or whatever created the text file, inserts spaces instead of using the TAB character, this option has no effect.

Example   **A>PIP CON:=B:PROGRAM.ASM[T10]**

14. Transfer between user areas

Format   **[Gn]**

Normally, it is not possible to use files from other than the current user area. However, specifying this option allows transfer of files from user area n to the current area.

Example   **C>PIP A:TEST.DOC=A:DEMO.DOC[G3]**

15. Truncate lines of data

Format   **[Dn]**

This option allows truncation of lines at column n; that is, PIP deletes all characters between column n and the next carriage return.

Example   **A>PIP LST:=PROGRAM.BAS[D80]**

16. Uppercase conversion

Format   **[U]**

This is the opposite of the [L] option; it converts all lowercase characters to uppercase.

Example   A > PIP TTY: = BIGTYPE.TXT[U]

17. Verify the copy

Format   [V]

Verifying a file as it is copied acts as a double check on its integrity. When given this option PIP compares the copy it has made with the original as it goes along, ensuring a faithful reproduction containing only those errors that were in the original.

Example   A > PIP B: = PERFECT.COM[V]

18. Write to a read/only file

Format   [W]

If you have files which have been set to read-only with STAT, you can copy over them if you give this option (PIP does not ask if you want the existing file erased and overwritten). It is not possible to reverse the process if you make a mistake; use with care!

Example   A > PIP A: = B:SECURE.COM[W]

19. Zero parity setting

Format   [Z]

The highest bit of each byte is usually the parity bit, and this option sets all highest-order bits to zero, thus converting 8-bit ASCII bytes to 7-bit ASCII bytes. When using this option make sure that none of the characters sent use this bit because otherwise you could get some strange results. For example, graphics characters and some console ESC codes would be changed.

Example   A > PIP C: = B:ORDINARY.FIL[Z]

5.3.6 Using the PIP * prompt

If you want to transfer a large number of files or transfer files between two data disks, it may be more convenient to give the PIP command on its own, producing the * prompt:

The command string can then be typed for each operation. For example to copy all COM files to drive A: from drive C:, use PIP as follows:

```
C>PIP
*A: = C: *.COM

COPYING
PIP.COM
STAT.COM
CONFIG.COM
*
```

To output a file to the screen:

```
C>PIP
*CON: = MEMO.DOC
```

At the * prompt you can type in any PIP commands you like without having to load PIP for each operation. This can save a great deal of time if there are a number of operations to be carried out.

Once you have finished, pressing the RETURN key, or the STOP key will return you to the system prompt on the drive from which you entered PIP (the default drive), or to the MENU if it is switched on.

5.4 STAT

The STAT program is used to display the STATistics or STATus of the various disk drives. This makes it one of the most useful utility programs. Many CP/M users do not use the full facilities provided by STAT. The following information is therefore provided as a list of operations, with a summary at the end.

5.4.1 Using the STAT program
1. Change device assignments

Format   **STAT logical: = physical:**

The device assignments can be altered with this command. However, it is more likely that the CONFIG program would be used instead since the devices are named in real terms rather than as codes.

For those who are familiar with the STAT command, the following table shows correspondance between the physical devices and those implemented:

LST:	TTY: Serial (printer)	CRT: Cartridge Printer	LPT: RS-232C (printer)	UL1: not implemented
PUN:	TTY: not implemented	PTP: LCD display	UP1: RS-232C	UP2: not implemented
RDR:	TTY: Keyboard	PTR: not implemented	UR1 RS-232C	UR2: not implemented
CON: Output Input	TTY: RS-232C Keyboard	CRT: LCD Keyboard	BAT: LCD RS-232C	UC1: RS-232C RS-232C

For instance, to tell the computer that the printer is now attached to the serial port instead of the RS232-C port, the command

C>STAT LST: = TTY:

is given, after which all output destined for the printer is sent to the serial port instead of the RS-232C port. Then, if the STAT DEV: command is given, the result will be:

CON: is CRT:
RDR: is UR1:
PUN: is UP1:
LST: is TTY:

2. Disk characteristics

Format   **STAT DSK:**

The complete status of a disk is displayed using this command. It shows the status of both the current disk and that of any others that have been accessed during the same session:

This command displays the characteristics of the disks accessed, such as its capacity; for example:

A > C:STAT DSK:

A:	Drive characteristics	(drive name)
72:	128 Byte Record Capacity	(no.of 128 byte records allowed)
9:	Kilobyte Drive Capacity	(formatted capacity of drive)
16:	32 Byte Directory Entries	(no.and size of directory entries)
0:	Checked Directory Entries	(no.of checked directory entries)
128:	Records/Extent	(no.of records per extent)
8:	Records/Block	(no.of records per block)
64:	Sectors/Track	(no.of sectors per track)
0:	Reserved Tracks	(no.of tracks reserved for CP/M)

3. Help

Format   **STAT VAL:**

This acts as a sort of HELP command. It shows the formats of the various STAT commands which can be given to obtain information or alter device attributes and assignments:

C>STAT VAL:

Temp R/O Disk: d: = R/O
Set Indicator: d:filename.typ $R/O $R/W $SYS $DIR
Disk Status: DSK: d:DSK:
User Status: USR:
Iobyte Assign:
CON: = TTY: CRT: BAT: UC1:
RDR: = TTY: PTR: UR1: UR2:
PUN: = TTY: PTP: UP1: UP2:
LST: = TTY: CRT: LPT: UL1:

4. Display device assignments

Format   **STAT DEV:**

This shows which physical devices are assigned to the various logical devices. To check the devices by name, use the CONFIG program.

C>STAT DEV:

CON: is CRT:
RDR: is UR1:
PUN: is UP1:
LST: is LPT:

5. Read/only - protect all the files on a disk

Format   **STAT drivename: = R/O**

An entire disk can be set to read/only with this command. The read/only setting remains effective until either a warm or a cold start

is made:

C > STAT D: = R/O

The Read/Only command protects the files on a disk so that they cannot be erased or written to. If you try to write or erase a file with the R/O attribute, the following error message is displayed:

D > ERA LETTER DOC BDOS ERROR ON A: R/O

Pressing either the RETURN key, the STOP key, or CTRL - C will return you to the prompt.

It is also possible to protect or un-protect single files with STAT.

6. Read/only - protecting a file

Format   **STAT drivename:filename.filetype $R/O**

Any file can be set to read/only using this format. This prevents the file from being altered until it is reset to read/write:

C > STAT A:DOCUMENT.TXT $R/O

DOCUMENT.TXT set to R/O

7. Read/write - un-protecting a file

Format   **STAT drivename:filename.filetype $R/W**

This resets a file to allow it to be written to as well as read.

C > STAT A:DOCUMENT.TXT $R/W

DOCUMENT.TXT set to R/W

If a file is protected and the whole disk is subsequently protected, the file will still be protected when a warm or cold boot is made to remove protection from the disk.

8. Hide from directory - specified file

Format   **STAT drivename:filename.filetype $SYS**

It is possible to give a file SYStem status using this command. This effectively removes its name from the directory so it cannot be used by anyone who does not know it exists:

C>STAT A:DOCUMENT.TXT $SYS

DOCUMENT.TXT set to SYS

If a STATus is carried out on the file when it is set to a SYS file, it shows the filename in brackets

C>STAT A:DOCUMENT.TXT

Recs	Bytes	Ext Acc
41	6k	1 R/O A:(STAT.COM)

Bytes Remaining On A: 3k

9. Restore to directory - specified file

Format   **STAT drivename:filename.filetype $DIR**

This countermands the previous format, resetting the file so that it is displayed in the directory:

C>STAT A:DOCUMENT.TXT $DIR

DOCUMENT.TXT set to DIR

Recs	Bytes	Ext	Acc	
58	8k	1	R/W	A:PIP.COM

Bytes remaining on A: 0k

d) Files containing specific characters

A > STAT D:DEMO??.BAS

Recs	Bytes	Ext	Acc	
20	3k	1	R/W	D:DEMO1.BAS
16	2k	1	R/O	D:DEMO13.BAS
14	2k	1	R/W	D:DEMO1A.BAS

Bytes remaining on D: 258k

11. Size and attributes - specified file

Format   **STAT drivename:filename.filetype $S**

Using this form of the command will give the same information as without the $S option, but with the addition of the size of the file. This value is the same as the number of records for sequential access files, and is generally used to show the amount of space that has been reserved for a random access file. This is because a sequential file simply takes up space as it is added to, and a random access file has an amount of space allocated to it when it is created:

A > STAT A:DOCUMENT. * $S

Size	Recs	Bytes	Ext	Acc	
16	6	2k	1	R/W	A:DOCUMENT.TXT
6	6	2k	1	R/W	A:DOCUMENT.BAS

Bytes remaining on A: 4k

12. Space remaining on disk

Format   **STAT**

This form of the command will display the amount of space available on the current drive and on any other drives which have been accessed during the current session. It also shows the drives' read/write attributes:

a) **C > STAT**

C: R/O   Space: 33k

b) **C > STAT**

A: R/W   Space: 0k
C: R/O   Space: 33k
H: R/W   Space: 24k

13. Space remaining on specified disk

Format   **STAT drivename:**

This form of the command gives the amount of space remaining on the specified drive:

C > STAT A:

Bytes Remaining On A: 0k

14. User STATUS

Format   **STAT USR:**

This format is used to display the current USR number and USR numbers under which there are active files on the disk:

A > STAT USR:

Active User: 0
Active Files: 0 1

This indicates that the current USR number is 0 and that USR numbers 0 and 1 both have active files on the disk.

5.4.2 Summary of STAT commands

STAT
    SPACE REMAINING ON DISK
STAT DEV:
    LOGICAL TO PHYSICAL ASSIGNMENTS
STAT drivename:
    SPACE REMAINING ON SPECIFIED DISK
STAT drivename: = R/O
    READ/ONLY - SET SPECIFIED DISK
STAT drivename:filename.filetype
    SIZE AND ATTRIBUTES - SPECIFIED FILE
STAT drivename:filename.filetype $DIR
    REPLACE IN DIRECTORY - SPECIFIED FILE
STAT drivename:filename.filetype $R/O
    READ/ONLY - SET SPECIFIED FILE
STAT drivename:filename.filetype $R/W
    READ/WRITE - SET SPECIFIED FILE
STAT drivename:filename.filetype $S
    SIZE AND ATTRIBES - SPECIFIED FILE
STAT drivename:filename.filetype $SYS
    REMOVE FROM DIRECTORY - SPECIFIED FILE
STAT DSK:
    DISK STATUS
STAT logical: = physical:
    CHANGE DEVICE ASSIGNMENTS
STAT USR:
    USER STATUS
STAT VAL:
    HELP

5.5 TERM

The TERM program makes it possible to connect PX-4 to a host computer through the RS-232C interface or direct modem for use as a terminal.

The TERM program can be started by entering the TERM command.

Example: A > C:TERM

When the TERM command is entered, the following screen is displayed.

```
TERM (c) Copyright 1984 by EPSON V1.0
A telecommunication via RS-232C Port.

The RS-232C status is :
rate=4800  data=8  stop=2  Parity=NONE
xon/xoff=disable   si/so=disable

Use CONFIG Program to change the status
```

NOTE:
When the direct modem is used, "D-MODEM" is displayed instead of "RS-232C."

Pressing any key changes the display as follows.

```
Send modes of TERM
  1 = Normal.
  2 = Insert LF after CR.
  3 = D--Delete LF after CR.  K--Normal.
  4 = D,K--Change CR(,LF) for ETX.
      K--Change ^C,STOP for CR.
    D---Disk  K--Key Board
Select a mode  1
```

Enter any of 1 to 4 to select a mode, then press the [RETURN] key; PX-4 then enters the terminal mode. Pressing [SHIFT] + [ESC] in the terminal mode displays the following screen so that the current RS-232C status and [PF] key functions can be obtained.

```
*** RS-232C STATUS ***
rate=4800   data=8   stop=2   parity=NONE
xon/xoff=disable    si/so=disable

*** PF KEY DISPLAY ***
 PF1/6      PF2/7      PF3/8      PF4/9     PF5/10
DISPLAY    PRINT      SEND       RECEIVE
  ___       ___       ___         ___        exit
```

[PF] key functions other than RECEIVE and exit are displayed in uppercase letters when they are OFF and in reversed uppercase letters when they are ON. "-" indicates that no function is assigned to the key.

Display returns to the former screen when any of the following occurs.
(1) [SHIFT] + [ESC] is pressed again.
(2) Any of the valid [PF] keys is pressed.
(3) A valid key is pressed to input data while keyboard input display is ON.
(4) Data is received from the RS-232C interface or direct modem.
(5) An error occurs.

The functions of the [PF] keys are as follows.

PF1: Switches keyboard data display ON or OFF. The function indication alternates as follows.

When ON -- DISPLAY When OFF --

Display can be turned ON or OFF at any time. However, if keyboard input display is set to ON while receiving data, data input from the keyboard cannot be distinguished from that received. The default setting for keyboard data display is OFF.

PF2: Switches printer output ON or OFF. The function indication alternates as follows.

When ON -- PRINT When OFF --

"Send" and "Receive" indications are not displayed when this switch is ON.

This function switches output of receive data to the printer (connected to the parallel printer output connector) ON or OFF. Keyboard input data can be printed only when keyboard data display is ON and printer output is ON. However, output to the printer is inhibited during file data transfer. The printer connected must be equipped with a Centronics interface. The default setting for printer output is OFF.

PF3: Starts sending a file. The "Send" indication is displayed in uppercase letters while data is being sent. The "Print" and "Receive" indications are not displayed. First, TERM prompts for input of a file name. When the file exists, TERM then prompts the operator to enter the interval between characters, that following CR-LF sequences, and that following each 128-byte block. Each interval is set as a multiple (0 to 255) of 20 ms. The default settings for the first two intervals are 0 and that for the third is 175. This interval is required when files transferred are to be saved to a disk in a terminal floppy unit. After the intervals have been entered, TERM outputs the contents of the file to the RS-232C interface or direct modem. When data transfer is completed, the function key indications return to their initial state. File output can be stopped by pressing the PF3 key.

PF4: Starts receiving data. SHIFT + ESC is ignored until data transfer is completed. When a file name is entered, a file is created for storing data received. If code 1BH (ESC) is received, it is always converted into code 2EH (period " . ") before it is output to the printer. Pressing PF4 during data transfer closes the file and stops data reception.

PF10: Terminates TERM operation.

HELP: The TERM command outputs the BREAK signal (a start bit with a duration of 200 ms) to the RS-232C interface when the HELP key is pressed. (The Break signal is used to interrupt transmission by the other computer.)

The other PF keys have no functions.

Errors

When an error or a condition which requires a user decision is detected during TERM operation, a message is displayed. Messages displayed for each error/condition and procedures for handling them are as follows.

(1) RS-232C is not ready.
Cause: An attempt was made to output data to the RS-232C interface without connecting the RS-232C interface cable.
Handling: Connect the RS-232C interface cable, then press ⌷CTRL⌷ + ⌷STOP⌷ to reset the error and start file output.

(2) File not found
Cause: The specified output file does not exist.
Handling: Respecify using the correct file name.

(3) No file name specified
Cause: An attempt was made to send without specifying a file name.
Handling: Specify the file name.

(4) Bad file descriptor
Cause: The file name specified does not conform to the rules for specifying file descriptors.
Handling: Correctly specify the file name.

(5) Drive select error
Cause: A drive name other than A: to K: was specified.
Handling: Specify a drive name from A: to K:.

(6) Overwrite (Y/N) ?
Cause: This message is issued on the receiving side when a file with the specified name already exists.
Handling: Type in Y or N. If Y is input, the existing file is overwritten; if N is input, TERM prompts for specification of another file name.

(7) Communication error Press ESC to restart, STOP to exit from TERM.
Cause: A communication error (framing, buffer overflow, or receive overrun error) occurred, or the sending and receiving computers are not set with the same communication parameters (word length, parity, baud rate, etc.).
Handling: When this message appears, keys other than the following are ignored and the file being transferred must be resent from the beginning.

⌷ESC⌷ .... Restarts the program.
⌷STOP⌷ .... Ends the program.

When this message is displayed because the communication parameters have not been correctly set, end TERM operation and respecify the RS-232C settings with the CONFIG command.

(8) Directory full Press ESC to restart, STOP to exit from TERM.
Cause: The directory space on the disk is full.
Handling: When this message appears, keys other than the following are ignored.

ESC .... Restarts the program.
STOP .... Ends the program.

Change to another disk, then start the TERM program again. The file being transferred when the error occurred must be resent from the beginning.

(9) Disk full Press ESC to restart, STOP to exit from TERM.
Cause: There is no free space left on the disk.
Handling: When this message appears, keys other than the following are ignored.

ESC .... Restarts the program.
STOP .... Ends the program.

Change to another disk, then start the TERM program again.

(10) File close error
Cause: An error occurred while a file was being closed.
Handling: Change to another disk, then start the TERM program again.

Appendix A

HARDWARE SPECIFICATIONS

CPU and Memory

Main CPU:
    Z-80 compatible CMOS CPU
    Clock - 3.68 MHz
    RAM - 64KB
    ROM - 32KB
    ROM capsule - 64KB (Max.)

Slave CPU:
    7508 (4-bit CMOS CPU)
    Clock - 270 kHz
    Internal ROM - 4KB

Power Supply

Main power supply:
    Four AA-size dry cells (optional)
      (not chargeable)
    Ni-Cd battery pack
      Capacity - 450 mAH
      Nominal voltage - 4.8 V
      Charging current - 70 mA
      Charging time - Approx. 8 hours (when power
      is off)
    AC adapter

Backup power supply:
    Ni-Cd battery pack
      Capacity - 90 mAH
      Nominal voltage - 4.8 V
      Charging current - 1 mA

Keyboard

Standard keyboard
  Total number of keys 72
  Mode indicators 3 LEDs
Item keyboard
  Total number of keys 58
  Mode indicators 3 LEDs

Item keyboard
   Total number of keys   58
   Mode indicators   3 LEDs

LCD (Liquid Crystal Display)

Character mode: 40 characters × 8 lines
Graphic mode: 240 × 64 dot matrix
Character matrix: 6 × 8 dots

Buzzer

Piezoelectric buzzer
   Volume control impossible
   External buzzer connector pin assignment:

Pin No.	Symbol	I/O	Name
1	GND	—	Signal ground
2	EX	Out	Signal output
3	EX	Out	Signal output

ROM Capsule

Number of slots: 2
Capacity: 32KB/slot (Max.)
Type of ROM usable: PROM
                      27C64
                      27C256
                 MASK-ROM
                      61364
                      613128
                      613256

Serial Interface

Signal level: RS-232C level (±5 V)
Bit rate: 38400, 19200, 9600, 4800, 2400, 1200, 600, 300, 200, 150, 110 bps
                  1200/75 or 75/1200 bps for Tx/Rx
Format: 1 start bit plus 8 data bits followed by 1 or 2 stop bits
Parity: Even, odd, none
Mode: Full duplex

External connector pin assignment:
                    See "3.4 Serial Interface."

RS-232C Interface

Signal level: RS-232C level ($\pm$ 5 V)
Bit rate: 38400, 19200, 9600, 4800, 2400, 1200, 600, 300,
                         200, 150, 110 bps
                         1200/75 or 75/1200 bps for Tx/Rx
Format: 1 start bit plus 8 data bits followed by 1 or 2 stop
                         bits
Parity: Even, odd, none
Mode: Full duplex
External connector pin assignment:
                    See "3.5 RS-232C Interface."

External Audio Cassette

Bit rate: Approx. 1300 bps
Remote control feature
External connector pin assignment:
                    See "3.6 Printer Interface."

Printer Interface

Conforming to Centronics Standard
External connector pin assignment:
                    See "3.6 Printer Interface."

Bar Code Reader Interface

External connector pin assignment:

Pin No.	Symbol	I/O	Name
1	GND	—	Signal ground
2	BRDT	In	Data read
3	+5	—	+5 V

Cartridge Interface

This interface is provided for optional cartridge devices such as RAM and
ROM cartridges, microcassette drive, A/D converter, cartridge printer. This
interface is equipped with both serial and parallel I/O ports. See "3.8 Car-
tridge Interface" for external connector pin assignment.

System Bus

Address bus:	16 bit parallel
Data bus:	8 bit parallel
Connector pin assignment:	See next page.
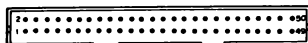
Pin No.	Symbol	I/O	Signal name	Signal level
1	VCH	P/S	Battery charger line	6 to 8V
2	VB1	P/S	Battery power	4.8 to 6.5V
3	VB2	P/S	Battery power	4.8 to 6.5V
4	VBK	P/S	Battery power	4.8 to 6.5V
5	GND	—	Signal ground	—
6	VL	P/S	Power for logics	4.5 to 6V
7	DB7		Data 7	
≀	≀	TTL	≀	TTL
14	DB0		Data 0	
15	$\overline{\text{MEN}}$	In	Internal memory enable	TTL
16	$\overline{\text{INTE}}$	In	External interrupt	TTL
17	$\overline{\text{WAIT}}$	In	Z-80 wait	TTL
18	$\overline{\text{PON}}$	Out	Power ON	TTL
19	$\overline{\text{CLK}}$	Out	Z-80 main clock	TTL
20	BUAK	Out	Bus acknowledge	TTL
21	$\overline{\text{RD}}$	Out	Z-80 data read	TTL
22	$\overline{\text{IORQ}}$	Out	Z-80 data request	TTL
23	$\overline{\text{WR}}$	Out	Z-80 data write	TTL
24	$\overline{\text{MRQ}}$	Out	Z-80 memory request	TTL
25	$\overline{\text{HLTA}}$	Out	Halt acknowledge	TTL
26	BURQ	In	Z-80 bus request	TTL
27	CG	—	Protective ground	—
28	CG	—	Protective ground	—
29	$\overline{\text{RS}}$	Out	System reset	TTL
30	$\overline{\text{M1}}$	Out	Z-80 machine cycle 1	TTL
31	AB0		Address 0	
≀	≀	Out	≀	TTL
46	AB15		Address 15	
47	OFF	Out	Gate array control at power switching	TTL
48	DW	Out	Expansion D-RAM RF control signal	TTL
49	DCAS	Out	Expansion D-RAM RF control signal	TTL
50	$\overline{\text{RSI}}$	In	Reset input	TTL

System Bus Pin Assignment

AC Adapter

Input voltage:	100 VAC ±10%
Frequency:	49 to 61 Hz
Output voltage:	6 V (400 mA)

External connector pin assignment:

Pin No.	Symbol	I/O	Name	Level
1	Vch	In	AC adapter output	6 to 8V
2				
3	GND	—	Ground	

DIP switch (in ROM capsule compartment)

- Not usable
- Can be used by the user.
- LST: device selection
- Keyboard device selection
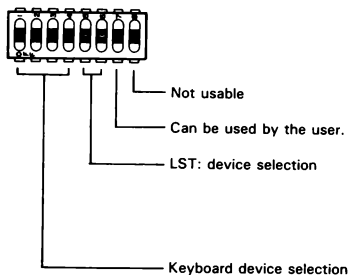
Device name	SW-5	SW-6
Serial interface	OFF	OFF
RS-232C interface	OFF	ON
Cartridge printer	ON	OFF
Printer interface	ON	ON

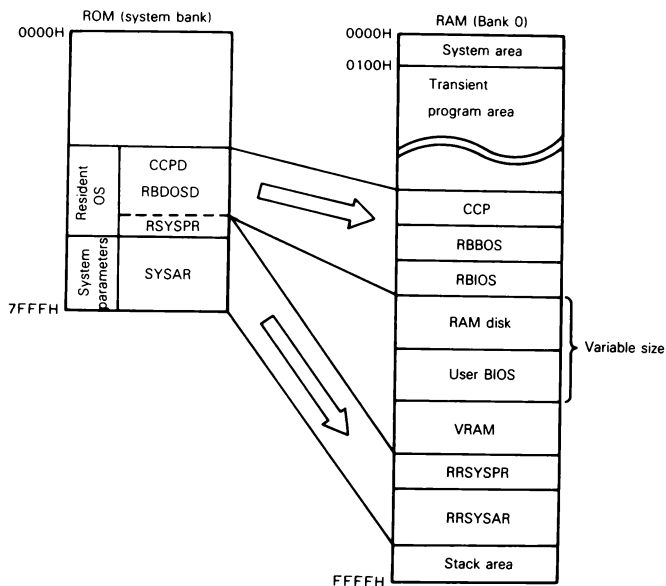| Keyboard type	SW-1	SW-2	SW-3	SW-4
ASCII	ON	ON	ON	ON
France	OFF	ON	ON	ON
German	ON	OFF	ON	ON
England	OFF	OFF	ON	ON
Denmark	ON	ON	OFF	ON
Sweden	OFF	ON	OFF	ON
Italy	ON	OFF	OFF	ON
Spain	OFF	OFF	OFF	ON
Norway	OFF	ON	ON	OFF

Appendix B

MEMORY MAPS AND MICROCASSETTE TAPE FORMAT

Memory map
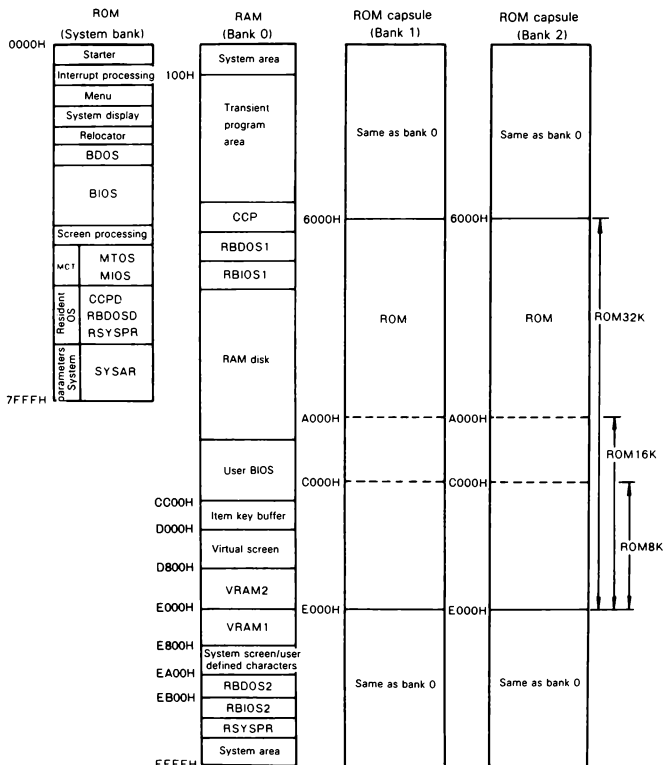
Part of the OS program and system parameters in RAM (bank 0) is relocated by the relocato as shown below.


The memory map of ROM capsule (banks 1 and 2) differs according to the size of ROM (8KB, 16KB and 32KB).

ROM size	ROM space	RAM space
8KB	C000H to E000H	0 to BFFFH, E000H to FFFFH
16KB	A000H to E000H	0 to 9FFFH, E000H to FFFFH
32KB	6000H to E000H	0 to 5FFFH, E000H to FFFFH

Microcassette tape format

Files are recorded on the microcassette tape in 256-byte blocks. Therefore, they are accessed in 256-byte blocks. The tape format is shown below.
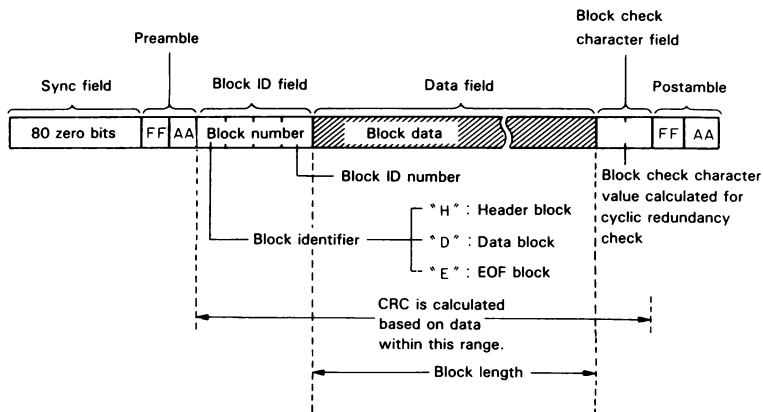
One tape (one volume) contains one directory and one or more data files. The directory consists of three blocks: the first block contains the tape and directory ID and the other two blocks contain file location and other file information. One file consists of one header block, one or more data blocks and one EOF block. Tape structure is shown below.
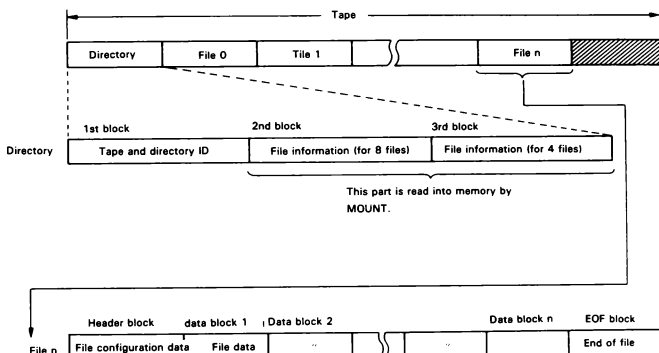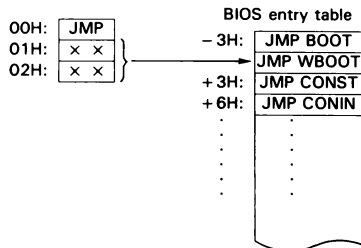
Appendix C

BIOS SUBROUTINES

CP/M BIOS (Basic Input and Output System) has many useful subroutines which can be used by application programs. To use a BIOS subroutine, set parameters in appropriate registers and call the entry address for that subroutine. The following table lists the entry addresses for BIOS subroutines which can be called by application programs.

Address (Hex.)	Entry name		Address (Hex.)	Entry name	
WBOOT – 3	BOOT		WBOOT + 45	(RSIN)	X
+ 0	WBOOT		+ 48	(RSOUT)	X
+ 3	CONST		+ 4B	TIMDAT	
+ 6	CONIN		+ 4E	MEMORY	
+ 9	CONOUT		+ 51	RSIOX	
+ C	LIST		+ 54	(LIGHTPEN)	X
+ F	PUNCH		+ 57	MASKI	
+ 12	READER		+ 5A	LOADX	
+ 15	HOME		+ 5D	STORX	
+ 18	SELDSK		+ 60	LDIRX	
+ 1B	SETTRK		+ 63	JUMPX	
+ 1E	SETSEC		+ 66	CALLX	
+ 21	SETDMA		+ 69	GETPFK	
+ 24	READ		+ 6C	PUTPFK	
+ 27	WRITE		+ 6F	READSW	
+ 2A	LISTST		+ 72	(SLAVE)	X
+ 2D	SECTRN		75	RDVRAM	
+ 30	PSET		+ 78	MCMTX	
+ 33	SCRNDUMP		+ 7B	POWEROFF	
+ 36	BEEP		+ 7E	(USERBIOS)	X
+ 39	(RSOPEN)	X	+ 81	AUTOST	
+ 3C	(RSCLOSE)	X	+ 84	RESIDENT	
+ 3F	(RSINST)	X	+ 87	CONTINUE	
+ 42	(RSINST)	X			

X: Not supported by PX-4 OS. (Entry address only)

Although the absolute address of WBOOT varies according to the sizes of RAM disk and user BIOS area, locations 01H and 02H always contain the absolute address of WBOOT. Therefore, you can obtain the absolute addresses of other entry points easily.

Example 1: CONIN can be called as follows.


```
                                : SET CONIN ENTRY
        LD    HL. (01H)         : GET (JMP WBOOT) ADDRESS FROM 0 PAGE
        ADD   HL. BC            : ADD 6
        LD    (ADRS). HL        : STORE (JMP CONIN) ADDRESS
        DB    0CDH              : CALL (JMP CONIN)
ADRS:   DB    0,0               : ADDRESS AREA
```

Example 2: CONIN can also be called from a BASIC program as follows.

```
10 STAD = &H50000
20 FOR I = 1 TO 14
30 READ A
40 POKE STAD. A          Store the machine language program shown in
50 STAD = STAD + 1       Example 1 starting at 5000H.
60 NEXT I
70 DEF USR1 = &H5000
80 X = USR1(X)
90 DATA &H01,&H06,&H00,&H2A,&H01,&H00,&H09,&H22,
&H0B,&HA0,&HCD,&H00,&H00,&HC9
```

C-2

The BIOS functions and user interfaces are described in the following. The contents of registers other than those to which a BIOS routine returns information are not assured after that routine has been executed unless otherwise specified. Therefore, the required contents of registers should be saved before calling a BIOS routine. Parameter blocks which are passed to or from a BIOS routine must be in the same memory bank as that from which the BIOS routine is called.

BOOT

Function: CP/M cold start bootstrap loader
Entry address: WBOOT - 3H
Entry parameters: None
Return parameters: C = 00H
NOTE: This routine is used only when system initialization is made, [SHIFT] + [GRPH] are pressed together with the reset switch or the 7508 sub-CPU is reset. This routin is not used by the user.

WBOOT

Function: CP/M warm start bootstrap loader
Entry address: WBOOT + 0H
Entry parameters: None
Return parameters: C = drive number
NOTE: This routine is used when JUMP 0 is executed in an application program or power is turned on in the restart mode.

CONST

Function: Reads the console status.
Entry address: WBOOT + 3H
Entry parameters: None
Return parameters: A = 00H Indicates that the console input buffer is empty.
A = FFH Indicates that the console input buffer contains characters.

CONIN

Function: Reads a character from the console.
Entry address: WBOOT + 6H
Entry parameters: None
Return parameters: A = ASCII code for the character read
(Register C is used if necessary.)

CONOUT
Function: Outputs a character to console
Entry address: WBOOT + 9H
Entry parameters: C = ASCII   code for character to be output
Return parameters: None.

LIST
Function: Outputs a character to the LST: device.
Entry address: WBOOT + 0CH
Entry parameters: C = character to be output
Return parameters: None.
NOTE: If the device is not ready, this routine loops until it becomes ready.

PUNCH
Function: Outputs a character to the PUN: device.
Entry address: WBOOT + 0FH
Entry parameters: C = character to be output
Return parameters: None.

READER
Function: Reads a character from the RDR: device.
Entry address: WBOOT + 12H
Entry parameters: None.
Return parameters: A = character read
*NOTE: This routine loops until a character is read from the device which
is assigned to RDR:.*

HOME
Function: Sets the track to zero.
Entry address: WBOOT + 15H
Entry parameters: None.
Return parameters: None.

SELDSK

   Function: Specifies a disk drive.
   Entry address: WBOOT + 18H
   Entry parameters: C =

0: Drive A	(built-in/external RAM disk)
1: Drive B	(ROM capsule)
2: Drive C	(ROM capsule)
3: Drive D	(Floppy disk drive 1)
4: Drive E	(Floppy disk drive 2)
5: Drive F	(Floppy disk drive 3)
6: Drive G	(Floppy disk drive 4)
7: Drive H	(Microcassette drive)
8: Drive I	(RAM cartridge)
9: Drive J	(ROM cartridge 1)
10: Drive K	(ROM cartridge 2)

   Return parameters: HL = 00H: Parameter error
                                      HL ≠ 00H: disk parameter block address

SETTRK

   Function: Selects the track to be read or written.
   Entry address: WBOOT + 1BH
   Entry parameters: BC = track number
   Return parameters: None.
   NOTE: The track number which can be specified is as follows.

Drive	Range
A	0 — 15
B	0 — 8
C	0 — 8
D	0 — 39
E	0 — 39
F	0 — 39
G	0 — 39
H	0 — 4
I	0 — 7
J	0 — 8
K	0 — 8

   *NOTE: If the track number specified is out of the range, an error will result
   when a READ or WRITE is performed. (In practice, the maximum
   value of the track number is limited by the capacity of the device
   installed.)*

SETSEC

Function: Selects the sector to be read or written.
Entry address: WBOOT + 1EH
Entry parameters: BC = sector number (0 to 63)
Return parameters: None.
NOTE: The range of the sector number is from 0 to 63 (3FH). If a value out of this range is specified, an error will result when a READ or WRITE is performed.

SETDMA

Function: Specifies the DMA address for disk access.
Entry address: WBOOT + 21H
Entry parameters: BC = DMA address
Return parameters: None.

READ

Function: Reads 128 bytes of data from a disk.
Entry address: WBOOT + 24H
Entry parameters: None.
Return parameters: A = 00H - Normal completion
A = other than 0 - Abnormal end

WRITE

Function: Writes 128 bytes of data to a disk.
Entry address: WBOOT + 27H
Entry parameters: C = 00H - Write standard format data
C = 01H - Write unblocked data
C = 02H - Write sequential file
Return parameters: A = 00H - Normal completion
A = other than 0 - Abnormal end

LISTST

Function: Reads the status of the LST: device.
Entry address: WBOOT + 2AH
Entry parameters: None.
Return parameters: A = 00H - Busy
A = FFH - Ready.

SECTRN

Function: Converts a logical sector number into a physical sector number.
Entry address: WBOOT + 2DH
Entry parameters: BC = logical sector number
Return parameters: HL = physical sector number

PSET

Function: Performs various operations on VRAM data.
Entry address: WBOOT + 30H
Entry parameters: B = data

C = type of operation   01H: AND
02H: OR
03H: XOR
Other values: no operation

HL = VRAM relative address
$0 \leq HL \leq 1919$

Return parameters: A = 00H - Normal completion
A = 01H - Address out of range
C = result of operation

NOTE: This routine performs the operation specified by register C between data at the VRAM address specified by register pair HL and data in register B, then places the result at that VRAM address and register C. The contents of register B and register pair HL are not changed.

SCRNDUMP

Function: Outputs the contents of VRAM to LST:.
Entry address: WBOOT + 33H
Entry parameters: None.
Return parameters: (LSTERR) = 00H - Normal completion
(LSTERR) = FFH - Ended by CTRL + STOP.
Location of LSTERR is 0F773H.

BEEP

Function: Sounds the speaker.

Entry address: WBOOT + 36H

Entry parameters: B = Note (13 to 60)   0: turns the speaker off

C = Interval (1 − 255) × 100 ms

Return parameters: A = 00H - Normal completion

= FFH - Ended by CTRL + STOP

NOTE: The relationship between the contents of register B and note is as follows. (No sound is generated when register B = 0.)

Octave Note	1	2	3	4	5
C		13	25	37	49
C#		14	26	38	50
D		15	27	39	51
D#		16	28	40	52
E		17	29	41	53
F		18	30	42	54
F#		19	31	43	55
G		20	32	44	56
G#		21	33	45	57
A		*22	34	46	58
A#		23	35	47	59
B		24	36	48	60

*: 440 Hz

NOTE: The pitch of sound can be specified as a frequency. Refer to the OS Reference Manual.

TIMDAT

Function: Performs the clock functions.

Entry address: WBOOT + 4BH

Explanation: This routine performs one of the six functions according to the contens of register C. The six functions are setting and reading the time, enabling and disabling the alarm function and reading and setting the alarm time. This routine uses a parameter block (referred to as the time descriptor) to obtain and return various information relating to the clock functions. This block is referred to as the time descriptor.

Time descriptor

Year (lower 2 digits)	2 BCD digits	1 byte
Month	2 BCD digits	1 byte
Day	2 BCD digits	1 byte
Hour	2 BCD digits	1 byte
Minute	2 BCD digits	1 byte
Second	2 BCD digits	1 byte
Weekday		1 byte
Type		1 byte
Address		2 bytes
Status		1 byte

Year: 00 - 99

Weekday: 0 - Sunday, 1 - Monday, ..., 6
          - Saturday

Address: Indicates the starting address of
          the area which contains the
          alarm message or wake string.

33 bytes max.

Length

Message or string

(1 byte)

The address indicates the address of this byte.

Type: 1 byte

    =0 (not defined)

    =1 Alarm

    =2 Wake

The address and type parameters must be set by the user before calling this routine.

When reading the alarm/wake setting, it is not necessary to set the type parameter.

Status: The system sets the status parameter as follows.

Set to 0 when an alarm/wake time is set. (function No. = 82)

Set to 1 when an alarm/wake interrupt occurs.

Set to 0 after the alarm/wake time has been read.

As shown above, the status is set to 1 only when an alarm/wake interrupt occurs; otherwise, it is always set to 0.

NOTE: Calling side bank information is automatically processed by BIOS.

A) TIMDAT (Read Time)

Function: Reads the time.

Entry parameters: C = 00H - Time read function

DE = Starting address of a 7 byte block for the time descriptor.

Return parameters: DE = Not changed

Time descriptor

Year (lower 2 digits)	2 BCD digits	1 byte
Month	2 BCD digits	1 byte
Day	2 BCD digits	1 byte
Hour	2 BCD digits	1 byte
Minute	2 BCD digits	1 byte
Second	2 BCD digits	1 byte
Weekday		1 byte

Weekday: 0 - Sunday, 1 - Monday, ... ,
6 - Saturday

B) TIMDAT (Set Time)

Function: Sets the time.

Entry parameters: C = FFH - Time set function

DE = Starting address of a 7 byte block for the time descriptor

Time descriptor

Year (lower 2 digits)	2 BCD digits	1 byte
Month	2 BCD digits	1 byte
Day	2 BCD digits	1 byte
Hour	2 BCD digits	1 byte
Minute	2 BCD digits	1 byte
Second	2 BCD digits	1 byte
Weekday		1 byte

Weekday: 0 - Sunday, 1 - Monday, ... ,
6 - Saturday

Return parameters: None. (DE = Not changed).

C) TIMDAT (Alarm/Wake enable)
Function: Enables the alarm/wake function.
Entry parameters: C = 80H - Alarm enable
Return parameters: None.

D) TIMDAT (Alarm/Wake disable)
Function: Disables the alarm/wake function.
Entry parameters: C = 81H - Alarm disable
Return parameters: None.

E) TIMDAT (Set Alarm/Wake)
Function: Sets the alarm/wake time.
Entry parameters: C = 82H - Alarm set
DE = Starting address of the time descriptor

Time descriptor

Year (lower 2 digits)	2 BCD digits	1 byte
Month	2 BCD digits	1 byte
Day	2 BCD digits	1 byte
Hour	2 BCD digits	1 byte
Minute	2 BCD digits	1 byte
Second	2 BCD digits	1 byte
Weekday		1 byte
Type		1 byte
Address		2 bytes

Year: 00 - 99

Weekday: 0 - Sunday, 1 - Monday, ... ,
6 - Saturday

Address: Indicates the starting address
of the area which contains the
alarm message or wake string.

Type: 1 byte

=0 (not defined)
=1 Alarm
=2 Wake

Return parameters: None. (DE = Not changed.)

F) TIMDAT (Read Alarm/Wake)

Function: Reads the alarm/wake time.

Entry parameters: C = 84H

DE = Starting address of the time descriptor

Time descriptor

Year (lower 2 digits)	2 BCD digits	1 byte
Month	2 BCD digits	1 byte
Day	2 BCD digits	1 byte
Hour	2 BCD digits	1 byte
Minute	2 BCD digits	1 byte
Second	2 BCD digits	1 byte
Weekday		1 byte
Type		1 byte
Address		2 bytes
Status		1 byte

Year: 00 - 99

Weekday: 0 - Sunday, 1 - Monday, ..., 6 - Saturday

Address: Indicates the starting address of the area which contains the alarm message or wake string.

Type: 1 byte
= 0 (not defined)
= 1 Alarm
= 2 Wake

Alarm: 1 byte
= 0 Not yet sounded
= 1 Sounded

Return parameters: None. (DE = Not changed)

NOTE: FFH is set to the year parameter byte and FH is set to the lower 4 bits for the second parameter byte.

To reset the alarm/wake function, to disable the function with function D, then zero all parameters with function E.

MEMORY

Function: Reads the current bank.

Entry address: WBOOT + 4EH

Entry parameters: None.

Return parameters: C = FFH - System bank
= 00H - Bank 0
= 01H - Bank 1
= 02H - Bank 2

RSIOX

Function: Performs serial I/O operation.

Entry address: WBOOT + 51H

Entry parameters: B = FXH

NOTE: This routine performs serial communication through the RS-232C, SIO and cartridge serial interfaces. The routine supports 12 functions and the setting of entry parameter FX for these functions are shown below.

```
FXH
 └──► Device      ⎧0: RS-232C
      (OPEN only) ⎪1: SIO
                  ⎨2: RS-232C input
                  ⎩3: Cartridge serial


                     ⎧1: OPEN    2: CLOSE
                     ⎪3: INSTS   4: OUTST
 └──► Function code  ⎨5: GET     6: PUT
                     ⎪7: CTRLIN  8: SETCTRL
                     ⎩9: ERSTS   F: SENSE
```
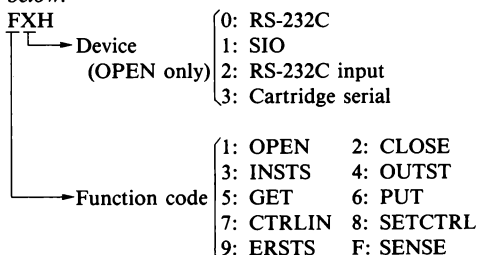
Explanation:

A) OPEN

Function: Opens the specified device.

Entry parameters: B = 1XH (X = 0 to 3)
HL = Starting address of the parameter block

(HL)→

Receive buffer address	2 bytes
Receive buffer size	2 bytes
Bit rate	1 byte
Word length	1 byte
Parity	1 byte
Stop bit	1 byte
Special parameter	1 byte

(Bit rate)
02H - 110 bps
04H - 150 bps
05H - 200 bps
06H - 300 bps
08H - 600 bps
0AH - 1200 bps
0CH - 2400 bps
0DH - 4800 bps
0EH - 9600 bps
0FH - 19200 bps
10H - 38400 bps
80H - 1200/75 bps (Tx/Rx)
81H - 75/1200 bps (Tx/Rx)
(Bit rate must be 300 bps when the modem is used.)

(Parity)
00H - Non-parity
01H - Odd parity
03H - Even parity

(Word length)
02H - 7 bits/character
03H - 8 bits/character

(Stop bit)
01H - 1 bit
03H - 2 bits

(Special parameter)

```
 7  6  5  4  3  2  1  0
┌──┬──┬──┬──┬──┬──┬──┬──┐
│ 1│ 1│ 1│  │ 1│  │  │  │
└──┴──┴──┴──┴──┴──┴──┴──┘
                    └── DTR ON
                 └───── RST ON
              └──────── SI/SO
           └─────────── XON/XOFF
```

Return parameters: A = 00H - Normal open, Z = 1
A = 02H - The interface already open, Z = 0
HL = Not changed

(HL) →	

Status flag	1 byte
Receive buffer get point	2 bytes
Receive buffer put point	2 bytes
*Receive buffer address	2 bytes
*Receive buffer size	2 bytes

(status flag)

```
7   6   5   4   3   2   1   0
┌───┬───┬───┬───┬───┬───┬───┬───┐
│   │   │   │   │   │   │   │   │
└───┴───┴───┴───┴───┴───┴───┴───┘
```

— Opened
— Receive buffer full
— Receive buffer overflow
— CD (line status for RS-232C)
— parity error
— Receive overrun
— Framing error
— DSR (control line for SIO, RS-232C)
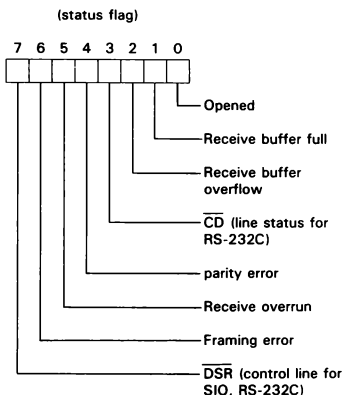
Bits 0 to 2 are used by the system. CD is active when "1" and DSR is active when "0".

(Receive buffer get point)
The pointer used to read data from the buffer.

(Receive buffer put pointer)
The pointer used to store received data in the buffer.

B) CLOSE

Function: Closed the currently used serial device.
Entry parameters: B = 20H
Return parameters: None.

C) INSTS

Function: Checks whether there is any data in the receive buffer.
Entry parameters: B = 30H
HL = Starting address of the 9 byte block which is used to store return information.
Return parameters: Z = 1 - Normal completion
A = FFH - Data has been received
= 00H - No data in the receive buffer
BC = Number of bytes received
HL = Not changed
The parameter block is the same as for OPEN.
Z = 0 - Abnormal end
A = 03H - Device not opened

D) OUTST

Function: Checks whether output is enable.
(Checks whether the Tx buffer is empty.)
Entry parameter: B = 40H
HL = Starting address of the 9 byte block which is used to store return information.
Return parameters: Z = 1 - Normal completion
A = FFH - Output enabled
= 00H - Output disabled
HL = Not changed
The parameter block is the same as for OPEN.
Z = 0 - Abnormal end
A = 03H - Device not opened

E) GET

Function: Reads 1 byte data from the receive buffer.
Entry parameters: B = 50H
HL = Starting address of the 9 byte block which is used to store return information.
Return parameters: Z = 1 - Normal completion
A = Receive data
HL = Not changed

The parameter block is the same as for OPEN.
Z = 0 - Abnormal end
A = 03H - Device not open
A = 04H - CTRL/STOP
A = 05H - receive buffer overflow

F) PUT

Function: Sends 1 byte data.
Entry parameters: B = 60H
C = Send data
HL = Starting address of the 9 byte block which is used to store return information.
Return parameters: Z = 1 - Normal completion
HL = Not changed (return information address)
Z = 0 - Abnormal end
A = 03H - Device not open
= 04H - CTRL + STOP pressed.
The parameter block is the same as for OPEN.

G) CTLIN

Function: Reads the status of the control line.
Entry parameters: B = 70H
Return parameters: Z = 1 - Normal completion

A = | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

DCD (line status for RS-232C)
CTS (RS-232C only)
DSR (control line for SIO, RS-232C)
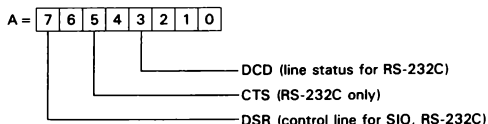
Z = 0 - Abnormal end
A = 03H - Device not open

H) SETCTL

Function: Sets the control lines.
Entry parameters: B = 80H

C = | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

DTR (control line for SIO, and RS-232C)
RTS (RS-232C only)
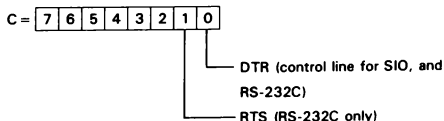
Return parameters: Z = 1 - Normal completion

Z = 0 - Abnormal end

A = 03H - Device already open

I) ERSTS

Function: Reads the error status and clears the error flags.

Entry parameters: B = 90H

Return parameters: Z = 1 - Normal completion

```
A =  7  6  5  4  3  2  1  0
```

Receive buffer overflow

$\overline{CD}$ status (line status for RS-232C)

Parity error

Receive overrun

Framing error

$\overline{DSR}$ status (control line for SIO)
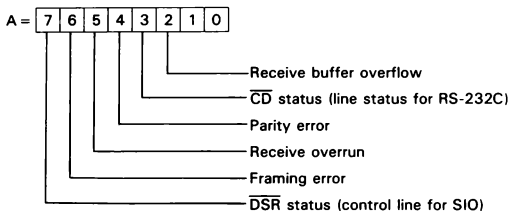
Z = 0 - Abnormal end

A = 03H - Device not open

J) SENS

Function: Reads the status of the serial device and RSBYTE.

Entry parameters: B = F0H

Return parameters:

```
     7  6  5  4  3  2  1  0
A = [              ]
```

Device

0: RS-232C

1: SIO

2: RS-232C for input SIO for output

3: Cartridge

4: Modem

F: None
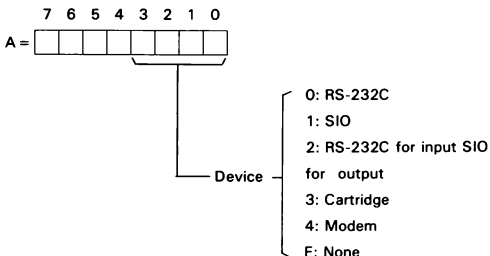
MASKI

Function: Sets and resets interrupt masks and enables and disables 7508 interrupts.

Entry adress: WBOOT + 57H

Entry parameters:

```
        7 6 5 4 3 2 1 0
B = [ | | | | | | | ]          Set and reset
```

- 7508 (slave)
- ART
- ICF (Input Capture Flag)
- IER
- OVF (Overflow Flag)
- EXT (Interrupt from system bus)
- 0: Sets or resets masks.
- 1: Reads mask status.

```
        7 6 5 4 3 2 1 0
C = [ | | | | | | | ]          7508 interrupt
```

Keyboard

Bit 1	Bit 0	
0	0	: Disables all key interrupts.
0	1	: Enables STOP key interrupt.
1	0	: Enables all key interrupt.
1	1	: " "

- Alarm interrupt
- Every-one-second interrupt
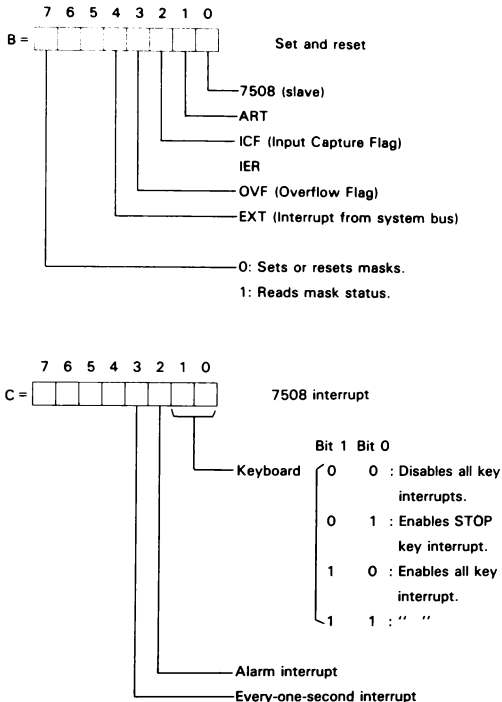
Each bit enables the corresponding interrupt when it is "1" and disables the interrupt when it is "0"

Return parameters: B = Previous IER status
C = Previous 7508 interrupt mask status
The contents of all registers other than registers B and C are not changed.

LOADX

Function: Reads one byte of data from the specified memory bank.

Entry address: WBOOT + 5AH

Entry parameters: C = FFH - System bank
C = 00H - Bank 0
C = 01H - Bank 1
C = 02H - Bank 2
HL = Data address (must be in the bank in which the calling program is present.)

Return parameters: A = read data
The contents of other registers are not changed.

STORX

Function: Writes one byte of data in the specified bank.

Entry address: WBOOT + 5DH

Entry parameters: C = FFH - System bank
C = 00H - Bank 0
C = 01H - Bank 1
C = 02H - Bank 2
A = Data to be written
HL = Address to which data is written (Must be in the called bank.)

Return parameters: None.
The contents of all registers are not changed.

LDIRX

Function: Transfers data from the specified bank to bank 0.

Entry address: WBOOT + 60H

Entry parameters: A = destination bank
A = FFH - System bank
A = 00H - Bank 0
A = 01H - Bank 1
A = 02H - Bank 2
HL = Starting address of the memory area in the source bank from which data is transferred
BC = Number of bytes transferred
DE = Starting address of the memory area in bank 0 to which data is transferred.

Return parameters: None.

JUMPX

Function: Jumps to the specified bank.

Entry address: WBOOT + 63H

Entry parameters: IX = destination address

ADRS = FFH - System bank

= 00H- Bank 0

= 01H- Bank 1

= 02H- Bank 2

ADRS is at 0F52EH.

Return parameters: None.

(Control is not returned to the calling program.)

NOTE: If a stack is used by the destination routine, new one must be set.

CALLX

Function: Calls a subroutine in the specified bank.

Entry address: WBOOT + 66H

Entry parameters: IX = destination address

ADRS = FFH - System bank

= 00H - Bank 0

= 01H - Bank 1

= 02H - Bank 2

ADRS is at 0F52EH.

Return parameters: Depending on the user subroutine called (except IX and IY).

NOTE: If a stack is used in the subroutine, new one must be set in the subroutine. The previous stack must be restored when control is returned to the calling program.

GETPFK

Function: Reads the string assigned to a function key.

Entry address: WBOOT + 69H

Entry parameters: C = Function key number

0-9: Function keys on the standard keyboard

40-7E: Item function key position code

HL = Starting address of the meory block into which the string is read.

Return parameters: None.

HL = Not changed.

NOTE: The format of the read buffer is as follows.

No. of char.	Char. 1	Char. 2		Char. n

(HL): Number of characters are that actually stored in the buffer and its maximum value is 15.
This routine allows the user who has the standard keyboard to use the functions assigned to item functions 40 to 7E. Bank information of the calling program is automatically processed by this routine.

PUTPFK

Function: Assigns a character string to the specified function key.

Entry address: WBOOT + 6CH

Entry parameters: C = Function key number or item function key control information

0H - 9H: Standard function key number

40-7EH: Item function key position code

FFH: Reset all function key assignments

FEH: Resets the item flag.

FDH: Sets the item flag.

HL = Starting address of the memory area which contains the string to be assigned to the specified key.

Return parameters: None.

HL = Not changed

NOTE: The format of the character string is as follows.

No. of char.	Char. 1	Char. 2		Char. n

(HL): The maximum number of characters is 15.
The item function specified is valid when the item flag is set.
This routine allows the user who has the standard keyboard to use the functions assigned to item functions 40 to 7E. Bank information of the calling program is automatically processed by this routine.

READSW

Function: Reads the status of switches.

Entry address: WBOOT + 6FH

Entry parameters: C = 02H - Read DIP SW status

C = 04H - Read power SW status

C = Other than 2 and 4 - No operation

Return parameters: 1) Read DIP SW status:

```
       7                   0
A =  | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
```
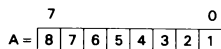
When each DIP switch position is
ON, the corresponding bit is set to
"1".

2) Read power switch status:

A = 00H: Power switch OFF

= 01H: Power switch ON

RDVRAM

Function: Reads the contents of the virtual screen.

Entry address: WBOOT + 75H

Entry address: B = Column at which read is to start (1 - m)

C = Line at which read is to start (1 - n)

DE = Number of characters to be read

HL = Starting address of the area in which data read is to be stored

Return parameters: A = 00H - Notmal completion

A = 01H - Read error

A = FFH - Parameter error

NOTE: M and n are determined by the virtual screen size and m must be 40 or 80 and n must be equal to or less than 25. If the screen end is encounterred during read, the remaining area is filled with blanks (20H) and register A is set to 01H.

The address specified and the calling program must be in the same bank.

All characters are returned in ASCII codes.

MCMTX

Function: Performs processings relating to the microcassette.

Entry address: WBOOT + 78H

NOTE: See the OS Reference Manual (sold separately).

POWEROFF

Function: Turns off the system's power.

Entry address: WBOOT + 7BH

Entry parameters: C = 00H - Turns off power in the continue mode.

C = 01H - Turns off power in the restart mode.

Return parameters: None.

USERBIOS

Function: BIOS entry for user coded BIOS routine

Entry address: WBOOT + 7EH

Entry parameters: Defined by the user.

Return parameters: Defined by the user.

Explanation: This entry is provided so that the user can code his own BIOS routine. The user must reserve the area for his routine (at the time of system initialize or using the CONFIG command) and write the starting address of the routine at the entry address. For details, refer to the OS Reference Manual (sold separately).

AUTOST

Function: Sets and cancels the auto start string.

Entry address: WBOOT + 81H

Entry parameters: C = 00H - Cancels the auto start string.

C = 01H - Sets an auto start string.

HL = Starting address of the area in which the string to be set is stored (Valid when C = 01H)

Length	

(HL)   Max. length is 32 bytes.

Return parameters: None.

RESIDENT

Function: Sets and resets the resident flag.

Entry address: WBOOT + 84H

Entry parameters: C = 00H - Resets the resident flag.

C = 01H - Sets the resident flag.

Return parameters: None.

CONTINUE

Function: Sets and resets the continue flag.

Entry address: WBOOT + 87H

Entry parameters:
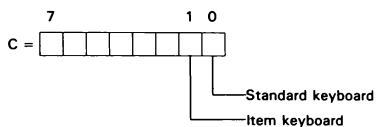
```
            7                 1   0
    C = [ ][ ][ ][ ][ ][ ][ ][ ]
                                  └──────Standard keyboard
                              └────────Item keyboard


        "1": Set
        "0": Reset
```

Return parameters: None.

Appendix D

CHARACTER CODE TABLE

Higher bits

Lower\Higher	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	HELP		SP	☺	@	P	`	p	+	☉	SP				⌂	
1			!	1	A	Q	a	q	⊥	♣					↵	
2		INS	"	2	B	R	b	r	⊤	♥						
3	STOP	PAUSE	#	3	C	S	c	s	⊣	◆						
4			$	4	D	T	d	t	⊢	♣						
5			%	5	E	U	e	u	−	♪						
6			&	6	F	V	f	v	|	☖						
7			'	7	G	W	g	w	⌐	↟						
8	BS		(	8	H	X	h	x	⌐	♨						
9	TAB		)	9	I	Y	i	y	L	☷						
A			*	:	J	Z	j	z	⌐	☫						
B	HOME	ESC	+	;	K	[	k	{	▓	↑						
C	CLR	→	,	<	L	¥	l	|	■	↓						
D	RET	←	−	=	M	]	m	}	▬	×						
E		·↑	.	>	N	^	n	~	▮	÷						
F		↓	/	?	O	_	o	△	●	±						

SP = space

D-1

Appendix E

CONSOLE CONTROL CODES

Code		Function
Decimal	Hexadecimal	
2	02	Moves the window 40 characters to the left.
5	05	Deletes characters to the end of the line from the cursor position.
6	06	Moves the window 40 characters to the right.
7	07	Sounds the speaker at 880 Hz.
8	08	Deletes the character to the left of the cursor position.
9	09	Moves the cursor to the next tab position.
10	0A	Moves the cursor down one line.
11	0B	Moves the cursor to the home position.
12	0C	Clears the currently selected virtual screen.
13	0D	Executes a command or statement.
16	10	Moves the window up one screen (7 or 8 lines).
17	11	Moves the window down one screen (7 or 8 lines).
26	1A	Erases all characters to the end of the virtual screen from the cursor position.
27	1B	Escape code
28	1C	Moves the cursor one character to the right.
29	1D	Moves the cursor one character to the left.
30	1E	Moves the cursor up one line.
31	1F	Moves the cursor down one line.

NOTE:
An escape code, followed by one or more characters is referred to as a escape sequence. The escape sequences are listed and explained in the OS Reference Manual (sold separately).

Cable set #723

Miniature 8-pin DIN connector

6-pin DIN connector

(PX-4)
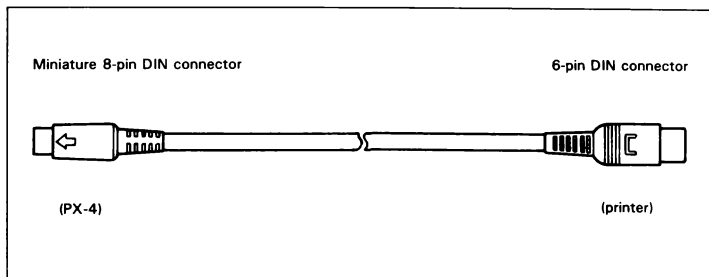
(printer)

Purpose: Connects P-40 or P-80 printer to the PX-4.

Connection: **Connecting a printer to the PX-4**
                     Connect the miniature 8-pin DIN connector to the
                     RS-232C or serial interface connector of the PX-4 and the
                     6-pin DIN connector to the 6-pin DIN connector of the
                     printer.

Pin assignments:

Miniature 8-pin DIN connector

6-pin DIN connector
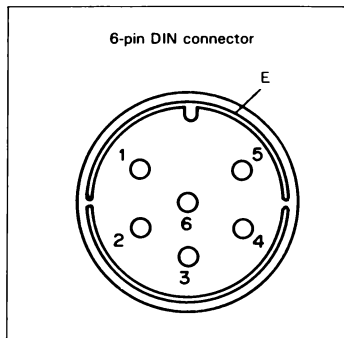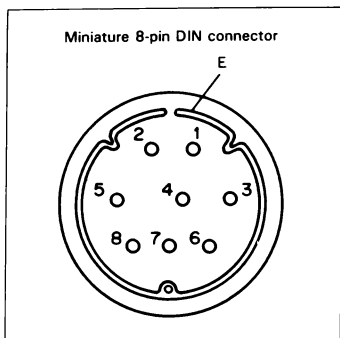
Miniature 8-pin DIN connector	6-pin DIN connector
1	5
2	3
3	1
4	
5	
6	2
7	4
8	
E	E
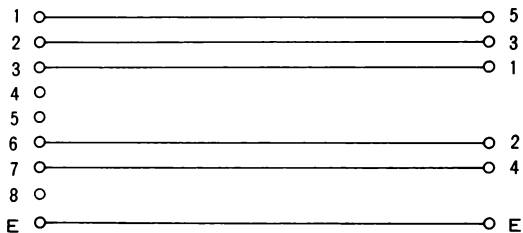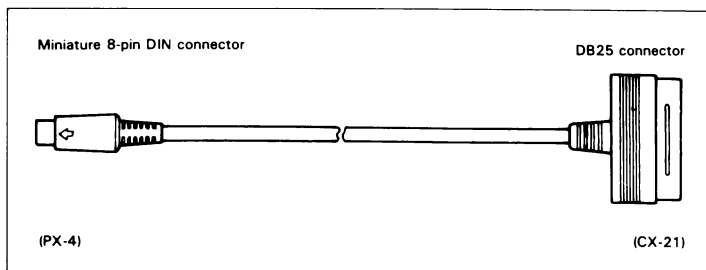
Cable set #724

Purpose: Connects a CX-21 acoustic coupler to the PX-4.
Connection: Connect the miniature 8-pin DIN connector to the RS-232C interface connector of the PX-4 and the DB25 connector to the CX-21.

Pin assignments:


```
E  o─────────────────────o  1
2  o─────────────────────o  2
3  o─────────────────────o  3
4  o─────────────────────o  4
5  o─────────────────────o  5
6  o─────────────────────o  6
1  o─────────────────────o  7
8  o─────────────────────o  8
7  o─────────────────────o  20
```

Miniature 8-pin DIN connector

DB25 connector

(PX-4)
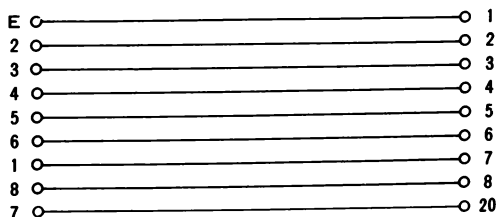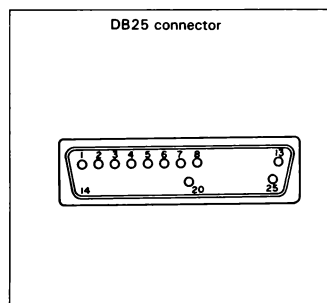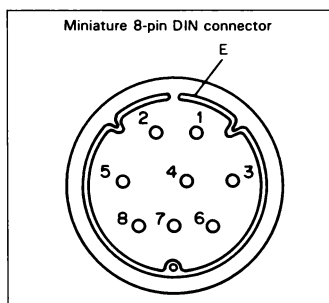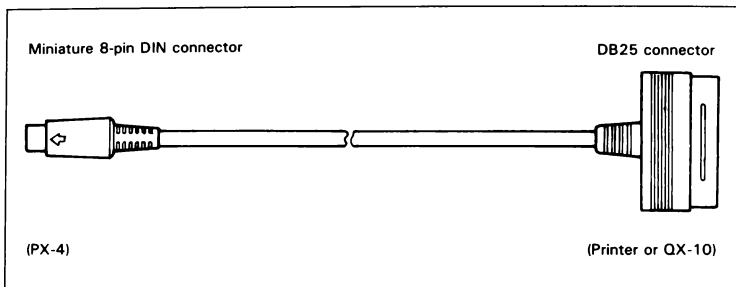
(Printer or QX-10)

Purpose: Connects a printer with an RS-232C interface or QX-10 to the PX-4.

Connection: **Connecting a printer to the PX-4.**

Connect the miniature 8-pin DIN connector to the RS-232C interface or serial connector (which is used is determined by the DIP switch in the ROM capsule compartment), then connect the DB25 connector to the RS-232C interface connector of the printer.

Connecting QX-10 to the PX-4

Connect the miniature 8-pin DIN connector to the RS-232C interface connector of the PX-4 and the DB25 connector to the RS-232C interface connector of the QX-10.

Miniature 8-pin DIN connector   Miniature 8-pin DIN connector

```
1  o────────────────────o  1
2  o────────────────────o  3
3  o────────────────────o  2
4  o──────┐                 o  8
5  o──────┘
6  o────────────────────o  7
7  o────────────────────o  6
8  o────────────────────o  4
                      ┌──o  5
E  o────────────────────o  E
```

Cable set #731

20-pin connector

36-pin connector

(PX-4)
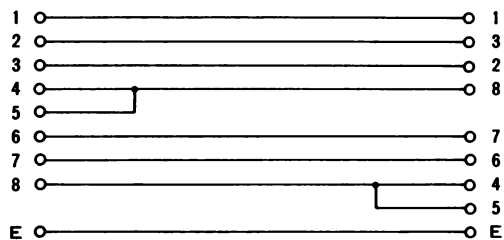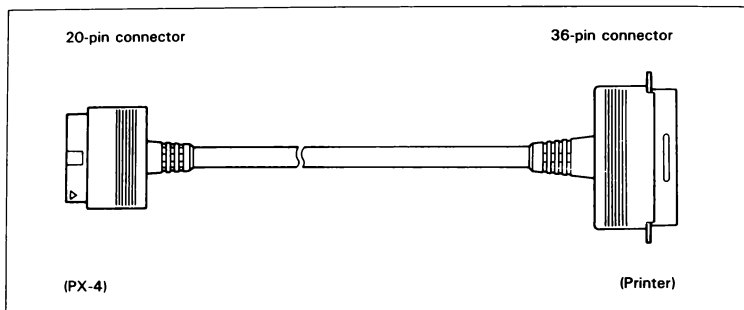
(Printer)

Purpose:	Connects a parallel printer to the PX-4.
Connection:	Connect the 20-pin connector to the printer interface connector of the PX-4 and the 36-pin connector to the parallel interface connector of the printer.

Pin assignment:

20-pin connector
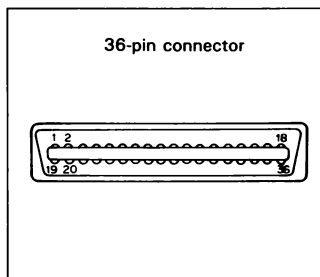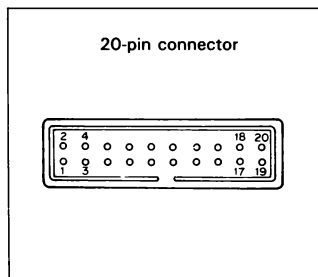
36-pin connector

36-pin connector   **20-pin connector**

```
 1 O———————┐           O 17
 2 O———————┘           O
 3 O——————————————————O 9
 4 O——————————————————O 11
 5 O——————————————————O 8
 7 O——————————————————O 7
 9 O——————————————————O 6
10 O——————————————————O 19
11 O——————————————————O 5
12 O——————————————————O 32
13 O——————————————————O 4
14 O——————————————————O 25
15 O——————————————————O 3
16 O——————————————————O 31
17 O——————————————————O 2
18 O——————————————————O 30
19 O——————————————————O 1
20 O——————————————————O 12
```

Miniature 5-pin DIN connector   3.5-mm and 2.5-mm plugs

White (3.5 mm) — EAR

Red (3.5 mm) — MIC

Black (2.5 mm) — REM
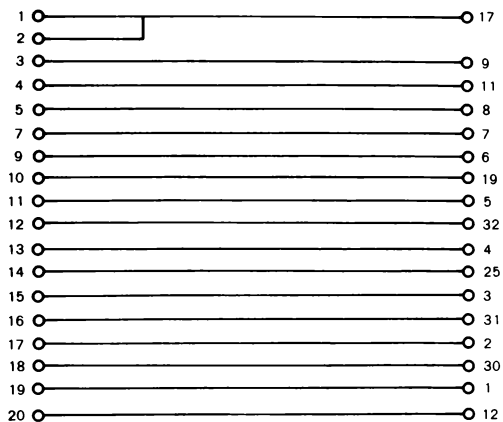
(PX-4)   (External cassette drive)
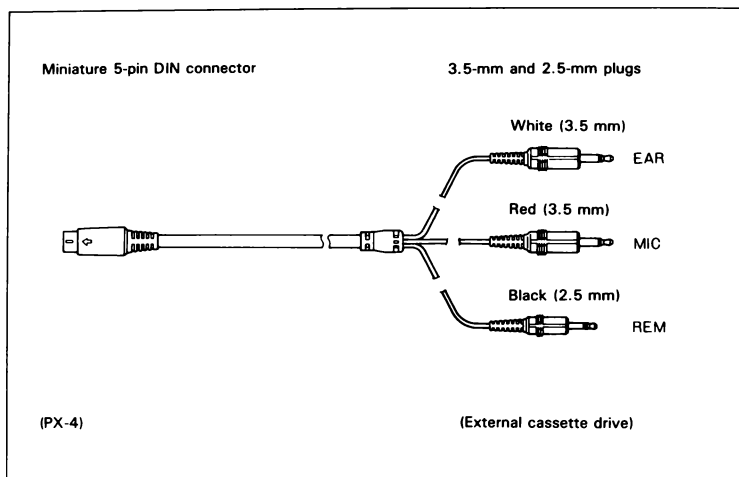
Purpose: Connects an external cassette drive to the PX-4.

Connection: Connect the miniature DIN connector to the external audio cassette interface connector. Insert the white plug to the EAR jack of the cassette drive, the red plug to the MIC jack and the black plug to the REM jack.

Pin assignment:

Miniature 5-pin DIN connector

E

1

2   3

4   5

3.5-mm or 2.5-mm plug

1   2
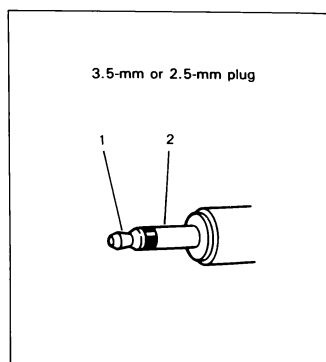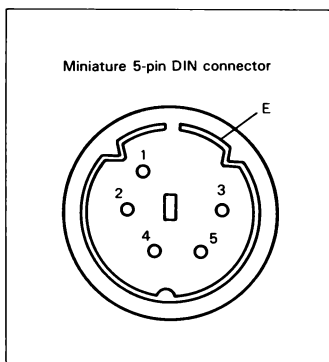
Miniature 5-pin DIN plug

3.5-mm and 2.5-mm plugs

1 ——————————————————○ White 2

○ Red 3

2 ○——————————————————○ Black 1

3 ○——————————————————○ Black 2

4 ○——————————————————○ Red 1

5 ○——————————————————○ White 2
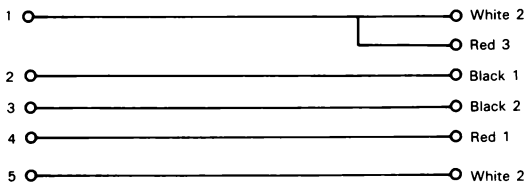
Appendix G

CP/M Errors and Messages

When using CP/M and the associated utilities, many possible errors can occur. Messages can come from different sources. They can be dislayed when there are errors in calls to the Basic Disk Operating System (BDOS). CP/M also displays errors when there are errors in command lines. The following list of error messages and sources of error covers errors in CP/M and the standard utilities. Some of these utilities may only be supplied on disk, but the error messages are presented as a single table to cover all these cases. Other application programs and the TERM and FILINK utility programs have their own error messages. Please consult the sections in this manual appropriate to these utilities or the manual provided with the application program, when using such programs.

Message	Meaning
?	This message has four possible meanings: 1) DDT does not understand the assembly language instruction. 2) The file cannot be opened. 3) A checksum error occurred in a HEX file. 4) The assembler/disassembler was overlayed.
ABORTED	You stopped a PIP operation by pressing a key.
ASM Error Messages	D Data error: data statement element cannot be placed in specified data area. E Expression error: expression cannot be evaluated during assembly. L Label error: label cannot appear in this context (might be duplicate label). N Not implemented: unimplemented features, such as macros, are trapped. O Overflow: expression is too complex to evaluate. P Phase error: label value changes on two passes through assembly. R Register error: the value specified as a register is incompatible with the code. S Syntax error: improperly formed expression.

Message	Meaning
	U Underlined label: label used does not exist.
	V Value error: improperly formed operand encountered in an expression.
BAD DELIMITER	Check command line for typing errors.
Bad Load	CCP error message, or SAVE error message.
Bdos Err On d:	Basic Disk Operating System Error on the designated drive: CP/M replaces d: with the drive specification of the drive where the error occurred. This message is followed by one of the four phrases in the situations described below.
Bdos Err On d: Bad Sector	This message appears when CP/M finds no disk in the drive, when the disk is improperly formatted, when the drive latch is open, or when power to the drive is off. Check for one of these situations and try again. This could also indicate a hardware problem or a worn or improperly formatted disk. Press CTRL-C to terminate the program and return to CP/M, or press the return key to ignore the error.
Bdos Err On d: File R/O	You tried to erase, rename, or set file attributes on a Read-Only file. The file should first be set to Ready-Write (RW) with the command: "STAT filespec $R/W."
Bdos Err On d: R/O	Drive has been assigned Read Only status with a STAT command, or the disk in the drive has been changed without being initialized with a CTRL-C. CP/M terminates the current program as soon as you press any key.
Bdos Err on d: Select	CP/M received a command line specifying a nonexistent drive. CP/M terminates the current program as soon as you press any key. Press return key or CTRL-C to recover.
Break "x" at c	"x" is one of the symbols described below and c is the command letter being executed when the error occurred. # Search failure. ED cannot find the string specified in an F, S, or N command. ? Unrecognized command letter c. ED does not recognize the indicated command letter, or an E, H, Q, or O command is not alone on its command line. O The file specified in an R command cannot be found.

Message	Meaning
	> Buffer full. ED cannot put any more characters in the memory buffer, or the string specified in an F, N, or S command is too long.
	E Command aborted. A keystroke at the console aborted command execution.
	F Disk or directory full. This error is followed by either the disk or directory full message. Refer to the recovery procedures listed under these messages.
CANNOT CLOSE DESTINATION FILE-{filespec}	An output file cannot be closed. You should take appropriate action after checking to see if the correct disk is in the drive and that the disk is not write protected.
Cannot close, R/O CANNOT CLOSE FILES	CP/M cannot write to the file. This usually occurs because the disk is write-protected.
	An output file cannot be closed. This is a fatal error that terminates ASM execution. Check to see that the disk is in the drive, and that the disk is not write-protected.
	The disk file written by a W command cannot be closed. This is a fatal error that terminates DDT execution. Check if the correct disk is in the drive and that the disk is not write-protected.
	This error can occur during SUBMIT file processing. Check if the correct system disk is in the A drive and that the disk is not write-protected. The SUBMIT job can be restarted after rebooting CP/M.
CANNOT READ	PIP cannot read the specified source. Reader may not be implemented.
CANNOT WRITE	The destination specified in the PIP command is illegal. You probably specified an input device as a destination.
Checksum error	A hex record checksum error was encountered. The hex record that produced the error must be corrected, probably by recreating the hex file.
CHECKSUM ERROR LOAD ADDRESS hhhh ERROR ADDRESS hhhh BYTES READ: hhhh:	File contains incorrect data. Regenerate hex file from the source.
Command Buffer Overflow	The SUBMIT buffer allows up to 2048 characters in the input file.

Message	Meaning
Command too long	A command in the SUBMIT file cannot exceed 125 characters.
CORRECT ERROR, TYPE RETURN OR CTRL-Z	A hex record checksum was encountered during the transfer of a hex file. The hex file with the checksum error should be corrected, probably by recreating the hex file.
DESTINATION IS R/O, DELETE (Y/N)?	The destination file specified in a PIP command already exists and it is Read Only. If you type Y, the destination file is deleted before the file copy is done.
Directory full	There is not enough directory space for file being written to the destination disk. You can use the OX filespec command to erase any unnecessary files on the disk without leaving the editor.
	There is not enough directory space to write the $$$.SUB file used for processing SUBMITs. Erase some files or select a new disk and retry.
Disk full	There is not enough disk space for the output file. This error can occur on the W, E, H, or X commands. If it occurs with X command, you can repeat the command prefixing the filename with a different drive.
DISK READ ERROR-{filespec}	The input disk file specified in a PIP command cannot be read properly. This is usually the result of an unexpected end-of-file. Correct the problem in your file.
DISK WRITE ERROR-{filespec}	A disk write operation cannot be successfully performed during a W command, probably due to a full disk. You should either erase some unnecessary files or get another disk with more space.
	A disk write operation cannot be successfully performed during a PIP command, probably due to a full disk. You should either erase some unnecessary files or get another disk with more space and execute PIP again.
	The SUBMIT program cannot write the $$$.SUB file to the disk. Erase some files, or select a new disk and try again.
ERROR: BAD PARAMETER	You entered an illegal parameter in a PIP command. Retype the entry correctly.

Message	Meaning
ERROR: CANNOT OPEN SOURCE, LOAD ADDRESS hhhh	Displayed if LOAD cannot find the specified file or if no filename is specified.
ERROR: CANNOT CLOSE FILE, LOAD ADDRESS hhhh	Caused by an error code returned by a BDOS function call. Disk may be write protected.
ERROR: CANNOT OPEN SOURCE, LOAD ADDRESS hhhh	Cannot find source file. Check disk directory.
ERROR: DISK READ, LOAD ADDRESS hhhh	Caused by an error code returned by a BDOS function call.
ERROR: DISK WRITE, LOAD ADDRESS hhhh	Destination Disk is full.
ERROR: INVERTED LOAD ADDRESS, LOAD ADDRESS hhhh	The address of a record was too far from the address of the previously-processed record. This is an internal limitation of LOAD, but it can be circumvented. Use DDT to read the hexfile into memory, then use a SAVE command to store the memory image file on disk.
ERROR: NO MORE DIRECTORY SPACE, LOAD ADDRESS hhhh	Disk directory is full.
Error on line nnn message	The SUBMIT program displays its messages in the format shown above, where nnn represents the line number of the SUBMIT file. Refer to the message following the line number.
FILE ERROR	Disk or directory is full, and ED cannot write anything more on the disk. This is a fatal error, so make sure there is enough space on the disk to hold a second copy of the file before invoking ED.
FILE EXISTS	You have asked CP/M to create or rename a file using a file specification that is already assigned to another file. Either delete the existing file or use another file specification.
	The new name specified is the name of a file that already exist. You cannot rename a file with the name of an existing file. If you want to replace an existing file with a newer version of the same file, either rename or erase the existing file, or use the PIP utility.

Message	Meaning
File exists, erase it	The destination filename already exists when you are placing the destination file on a different disk than the source. It should be erased or another disk selected to receive the output file.
FILE IS READ/ONLY	The file specified in the command to invoke ED has the Read Only attribute. ED can read the file so that the user can examine it, but ED cannot change a Read Only file.
File Not Found	CP/M cannot find the specified file. Check that you have entered the correct drive specification or that you have the correct disk in the drive.
	ED cannot find the specified file. Check that you have entered the correct drive specification or that you have the correct disk in the drive.
	STAT cannot find the specified file. The message might appear if you omit the drive specification. Check to see if the correct disk is in the drive.
FILE NOT FOUND- [filespec]	An input file that you have specified does not exist.
Filename required	You typed the ED command without a filename. Reenter the ED command followed by the name of the file you want to edit or create.
hhhh?? = dd	The ?? indicates DDT does not know how to represent the hexadecimal value dd encountered at address hhhh in 8080 assembly language. dd is not an 8080 machine instruction opcode.
Insufficient memory	There is not enough memory to load the file specified in an R or E command.
Invalid Assignment	You specified an invalid drive or file assignment, or misspelled a device name. This error message might be followed by a list of the valid file assignments that can follow a filename. If an invalid drive assignment was attempted the message "Use: d: = RO" is displayed, showing the proper syntax for drive assignments.
Invalid control character	The only valid control characters in the SUBMIT files of type SUB are ˆ A through ˆ Z. Note that in a SUBMIT file the control character is represented by typing the cir-

Message	Meaning
	cumflex, ˆ, not by pressing the control key.
INVALID DIGIT- {filespec}	An invalid hex digit has been encountered while reading a hex file. The hex file with the invalid hex digit should be corrected, probably by recreating the hex file.
Invalid Disk Assignment	Might appear if you follow the drive specification with anything except = R/O.
INVALID DISK SELECT	CP/M received a command line specifying a nonexistent drive, or the disk in the drive is improperly formatted. CP/M terminates the current program as soom as you press any key.
INVALID DRIVE NAME (Use A, B, C, or D)	SYSGEN recognizes only drives A, B, C and D as valid destinations for system generation.
Invalid File Indicator	Appears if you do not specify RO, RW, DIR, or SYS.
INVALID FORMAT	The format of your PIP command is illegal. See the description of the PIP command.
INVALID HEX DIGIT LOAD ADDRESS hhhh ERROR ADDRESS hhhh BYTES READ: hhhh	File contains incorrect hex digit.
INVALID MEMORY SIZE	Specify a value less than 64K or your computer's actual memory size.
INVALID SEPARATOR	You have placed an invalid character for a separator between two input filenames.
INVALID USER NUMBER	You have specified a user number greater than 15. User numbers are in the range 0 to 15.
n?	You specified a number greater than fifteen for a user area number. For example, if you type USER ⌐─┘, the screen displays 18?.
NO DIRECTORY SPACE	The disk directory is full. Erase some files to make room for PRN and HEX files. The directory can usually hold only 64 filenames.
NO DIRECTORY SPACE-{filespec}	There is not enough directory space for the output file. You should either erase some unnecessary files or get

Message	Meaning
	another disk with more directory space and execute PIP again.
NO FILE-(filespec)	CP/M cannot find the specified file, or no files exist.
	The indicated source or include file cannot be found on the indicated drive.
	The file specified in an R or E command cannot be found on the disk.
NO INPUT FILE PRESENT ON DISK	The file you requested does not exist.
No memory	There is not enough (buffer?) memory available for loading the program specified.
NO SOURCE FILE ON DISK	SYSGEN cannot find CP/M either in CPMxx.com form or on the system tracks of the source disk.
NO SOURCE FILE PRESENT	The assembler cannot find the file you specified. Either you mistyped the filespecification in you command line, or the file is not type ASM.
NO SPACE	Too many files are already on the disk, or no room is left on the disk to save the information.
No SUB file present	For SUBMIT to operate properly, you must create a file with filetype of SUB. The SUB file contains usual CP/M commands. Use one command per line.
NOT A CHARACTER SOURCE	The source specified in your PIP commands is illegal. You have probably specified an output device as a source.
NOT DELETED	PIP did not delete the file, which may have had the R/O attribute.
NOT FOUND	PIP cannot find the specified file.
OUTPUT FILE WRITE ERROR	You specified a write-protected diskette as the destination for the PRN and HEX files, or the diskette has no space left. Correct the program before assembling your program.
Parameter error	Within the SUBMIT file of type sub, valid parameters are $0 through $9.

Message	Meaning
PARAMETER ERROR, TYPE RETURN TO IGNORE	If you press return, SYSGEN proceeds without processing the invalid parameter.
QUIT NOT FOUND	The string argument to a Q parameter was not found in you input file.
Read error	An error occurred when reading the file specified in the type command. Check the disk and try again. The STAT filespec command can diagnose trouble.
READER STOPPING	Reader operation interrupted.
Record Too Long	PIP cannot process a record longer than 128 bytes.
START NOT FOUND	The string argument to an S parameter cannot be found in the source file.
SOURCE FILE INCOMPLETE	SYSGEN cannot use your CP/M source file.
SOURCE FILE NAME ERROR	When you assemble a file, you cannot use the wildcard characters * and ? in the filename. Only one file can be assembled at a time.
SOURCE FILE READ ERROR	The assembler cannot understand the information in the file containing the assembly language program Portions of another file might have been written over your assembly language file, or information was not properly saved on the diskette. Use the TYPE command to locate the error. Assembly language files contain the letters, symbols, and numbers that appear on your keyboard. If your screen displays unrecognizable output or behaves strangely, you have found where computer instructions have crept into your file.
SYNCHRONIZATION ERROR	The MOVCPM utility is being used with the wrong CP/M system.
"SYSTEM" FILE NOT ACCESSIBLE	You tried to access a file set to SYS with the STAT command.
TOO MANY FILES	There is not enough memory for STAT to sort the files specified, or more than 512 files were specified.
UNEXPECTED END OF HEX FILE-[filespec]	An end-of-file was encountered prior to a termination hex record. The hex file without a termination record should be corrected, probably by recreating the hex file.

Message	Meaning
Unrecognized Destination	Check command line for valid destination.
Use: STAT d: = RO	An invalid STAT drive command was given. The only valid drive assignment in STAT is STAT d: = RO.
VERIFY ERROR: -(filespec)	When copying with the V option, PIP found a difference when rereading the data just written and comparing it to the data in its memory buffer. Usually this indicates a failure of either the destination disk or drive.
XSUB ACTIVE	XSUB has been invoked.
XSUB ALREADY PRESENT	XSUB is already active in memory.
Your input?	If CP/M cannot find the command you specified, it returns the command name you entered followed by a question mark. Check that you have typed the command line correctly, or that the command you requested exists as a .COM file on the default or specified disk.

GLOSSARY

acoustic coupler

A device which converts digital electrical signals into acoustic signals for transmission over a telephone line, and which converts acoustic signals received over a telephone line into digital signals in a form which can be input by a computer.

address

A number which is used during data input/output to indicate a location in memory, an input/output port, or a position in an auxiliary storage device. Ordinarily, each byte in memory is indicated by a unique address. There are a variety of addressing schemes, including absolute addresses, relative addresses, and base addresses.

application program

A program which is used to do work for the user. Contrast with system program. Application programs may be prepared either by software manufacturers or the user himself, and may be written in any language supported by the computer. auxiliary storage - Devices which are used to supplement the computer's main storage, such as floppy disk units, ROM capsules, and magnetic tape.

ASCII code

An abbreviation for "American National Standard Code for Information Interchange." Uses a data word consisting of 7 bits (8 bits including parity) to represent the letters of the alphabet, numerals, and symbols.

bank

In this book, a 64K byte segment of main memory.

bar code

A code which uses of groups of vertical bars to represent numbers (and sometimes letters); can be optically scanned for input to a computer using a bar code reader.

4 902888 133688

bar code reader

A device which converts bar code patterns into electrical signals for input to a computer.

BASIC

An acronym for "Beginners' All Purpose Symbolic Instruction Code); an interactive programming language whose instructions and syntax closely resemble English.

bit

Abbreviated form of "binary digit"; the smallest unit of information handled by a computer. Can have either of two states: 1 or 0.

bit rate

The speed with which data bits are transferred during serial data communication through the RS-232C or serial interface; expressed in bits per second (bps). Also sometimes referred to as baud rate.

blocking

The process of combining two or more records into one block for output to an external device. The size of one block is predetermined based on factors such as memory size and speed with which data is transmitted to the external device.

buffer

An area in memory or a device which is used for temporary storage of data being transferred between two devices.

bus

One or more conductors which carry signals from one part of a computer to another.

byte

A sequence of bits which are handled by the computer as a unit. In PX-4, one byte consists of 8 bits, and can be used to represent values from 0 to 255. One byte corresponds to one character of text information. A unique address is assigned to each byte in memory, and each memory address can store one 8-bit value.

close

The process of ending access to a file. When a file is closed, its buffer can be reassigned to another file.

cold boot

With PX-4, the process by which the CP/M operating system is loaded into bank 0 from the system bank and started. A cold boot is made whenever the system initialization is performed or when the reset switch is pressed.

command

An instruction to the computer which is entered by the operator from the console (keyboard) or other external device.

console

The input/output device which is used for communication between the operator and the computer. With PX-4, the keyboard and LCD screen.

CP/M

A registered trademark of Digital Research. The characters stand for "control program for microcomputer". The operating system used in PX-4 and many other microcomputers.

CPU

An abbreviation for "central processing unit." The CPU consists of an arithmetic unit and control unit, and is equipped with memory and input/output devices.

deblocking

The process of dividing a block of data into several records.

directory

A list in memory or in an auxiliary storage medium which contains information needed to manage files in that medium (file names, the lengths of files, file attributes, and file storage locations).

DIP switch

A group of switches which are housed in a dual inline package (DIP) for mounting on a printed circuit board.

entry address

The address at which execution of a program begins. Program execution can be transferred from one program to another by making a jump or call to a given program's entry address.

entry parameter

Information which is passed from one program to another when a program is called. Information is ordinarily passed by placing it in one or more registers or locations in memory.

entry table

A table which lists entry addresses to various programs (routines).

EOF block

A block written to the end of a magnetic tape file to indicate that file's end.

even parity

See parity.

file

A group of related records which are handled as a single unit. Ordinarily refers to data stored under a common name on an auxiliary storage device.

floppy disk

A disk with a magnetic coating which is housed in a protective jacket and used for recording data. Floppy disks are made in a variety of sizes; some of the sizes which are currently used are 8-inch, 5.25-inch, and 3.5-inch. Floppy disks also vary according to whether one or both sides are used for recording (single sided and double sided), and recording density (single density or double density). Of the floppy disk units which can be used with PX-4, the TF-15 and TF-20 use 5.25-inch double sided, double density disks, while the PF-10 uses 3.5-inch double sided, double density disks.

formatting

The process of checking a new floppy disk for defects, preparing a directory area on the disk, and establishing the locations of tracks and sectors on the disk.

hardware

The physical components making up a computer; e.g., the CPU, screen and keyboard, and memory.

interface

The point at which two systems (such as the computer and the user) meet and interact. With external devices, the circuits and software through which connection is made to the computer. Also may indicate the physical connector through which two or more devices are interconnected.

item keyboard

A special keyboard whose keys are all redefinable, making it easy to use PX-4 as a special purpose machine.

K byte

Abbreviation for kilobyte.

kilobyte

2^{10} bytes.

LED

An abbreviation for "light emitting diode." Depending on the type of material used in its construction, an LED will emit red, yellow, or green light when voltage is applied to it.

logical device

The software interface between the user/computer and a physical device required for data processing (keyboard, screen, printer, disk drive, memory, or line). Use of logical devices makes it possible to select one physical device out of a group for use, and thus eliminates the need for reprogramming when switching from one physical device to another. In other words, the job of switching between physical devices is made the responsibility of system routines which the user can handle as if they were devices.

machine language program

A computer program consisting of binary instruction codes which can be directly understood and executed by a computer. Programs written in any programming language must be converted into machine language for execution by some type of conversion program (a compiler or interpreter).

memory

A computer's internal storage device. Data stored in memory can be recalled as necessary. Two types of memory are used in computers: random access memory (RAM), which can be both read and written by the computer's user, and read only memory (ROM) which is used for permanent storage of programs and other data.

modem

A device (modulator-demodulator) which is used for modulating signals for transmission over a communication line, and for demodulating signals received over such a line. Essential in online systems. Modems which are acoustically linked to the handset of a telephone unit are referred to as acoustic couplers.

odd parity

See parity.

open

The operation by which a file is prepared for access. When a file is opened, an area in memory is reserved for it which is used as a buffer for data input from or output to the file.

operating system

A system of program instructions which controls operation of a computer's hardware and provides an interface between the user and the computer to make it convenient to use. In PX-4, the operating system used is CP/M.

parameter

Variables or constants which are acted upon by subroutines or program functions. The result produced by the subroutine or function depends on the value of the parameter(s) specified.

parity

A parity bit is included in data transmitted through the RS-232C interface to make it possible for the receiving side to determine whether data received is valid. Either even parity or odd parity may be specified; with even parity, the parity bit is "0" if there is an even number of "1" data bits, and is "1" if there is an odd number of "1" data bits; the opposite is true when odd parity is specified.

parity check

A check for data validity the number of "1" bits in a data byte are check against the value of an accompanying parity bit. Also referred to as an odd-even check.

physical device

A device which is physically connected to the computer. Actual operation of a physical device is performed using a logical device name which may be assigned to any of several different physical devices.

power supply

A device which supplies electrical power to other devices.

RAM

Abbreviation for random access memory; i.e., memory whose contents can be changed and retrieved as necessary.

random access file

A type of file in which data records in any location can be accessed at any time, regardless of what record was accessed previously.

record

A collection of related items of data which are handled as a unit during data processing. A collection of records is referred to as a file.

register

A device which is used to store one or two bytes of data. The contents of a register can be read or written at any time. Registers used with the Z-80 microprocessor include the program counter, general registers, index register, and instruction register.

ROM

Abbreviation for read only memory; i.e., memory whose contents can be referenced but not changed. There are two general types of ROMs: mask ROMs, whose contents (programs, etc.) are written by the manufacturer at the time of production, and programmable ROMs (PROMs), which can be written by the user. PX-4 BASIC is provided in the form of a mask ROM.

scroll

Vertical or horizontal movement of all data displayed on the display screen.

sequential file

A file in which constituent records are recorded in a fixed order. Records in a sequential file can only be read in the order in which they were written when the file was created.

software

The program instructions which control operation of a computer.

subroutine

A subprogram which is called from some other point in the program being executed. A subroutine can be called from any point in the program; when subroutine execution is completed, execution resumes with the program instruction following the point at which the subroutine call was made. Use of subroutines helps make programs easier to read and debug and helps reduce the amount of memory required to do processing which is required at various points in the program. With BASIC programs, subroutines are called using the GOSUB statement; with machine language programs, calls are made using the CALL instruction.

system initialization

The process of establishing the system operating environment (such as type of printer) and system parameters such as the date/ time and RAM disk size.

terminal

An input/output device used for communicating with a central computer over a communication line. Ordinarily, data input from the keyboard of a terminal is transmitted to the central computer, and data received by the terminal from the central computer is displayed on the terminal's display screen.

transient command

Utility programs which are loaded into memory each time they are executed and which perform specific system-related functions, such as system initialization, file directory display, or transfer of files from one device to another.

user

In this manual, the person who uses a computer. Also sometimes used to refer to a program which utilizes the hardware and software resources of a computer system.

verify

The process of rereading data which has been written to an external storage device and comparing it with the original to ensure that it has been stored properly.

virtual screen

An area in memory whose contents can be viewed through the LCD screen. Provides a virtual display area whose dimensions exceed the physical capacity of the LCD screen. (See also: window screen.)

VRAM

Abbreviation for "video RAM." VRAM is an area in main memory which is used for storing characters and graphics which are displayed on the screen. With PX-4, the contents of VRAM can be accessed directly by the user.

window screen

An imaginary "window" through which the contents of the virtual screen are displayed on the LCD screen. Can be moved around to view different parts of the virtual screen.

warm boot

The processing of reloading part of the CP/M operating system into bank 0 from the system bank and initializing the various parts of CP/M. Initiated by pressing $\boxed{\text{CTRL}}$ + $\boxed{\text{C}}$ or the $\boxed{\text{STOP}}$ key.

Z-80

An 8-bit microprocessor which was developed by the Zilog Corporation of the United States and which is used as the CPU in many of today's 8-bit microcomputers.

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