Chapter 1

PX-16 General Overview

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Chapter 1 - PX-16 General Overview

1.1 The PX-16 Epson Portable Computer

1.1.1 The Concept of the PX-16

The PX-16 utilizes all of the various technologies developed through past Epson portables, starting with the HX-20, and is designed to serve as a machine for the VAR market to meet a wide range of user demands.

The PX-16 16-bit personal computer is compact in size (about the size of a sheet of typing paper), but offers MS-DOS Version 3.20 and GW-BASIC Version 3.20 on a ROM chip as standard equipment, as well as supporting full compatibility with the EPSON PCe and IBM PC/XT machines. In addition to the 4M bit system ROM, the PX-16 also supports a massive memory configuration consisting of main RAM 640KB (maximum), RAM disk 768KB (maximum), and three 4M bit (maximum) application ROM sockets.

The PX-16 is designed in the system component style to enable individual users in the diversifying office computer market to develop the system optimum for their needs in terms of application and budget. Keyboards, displays and other cartridges may be combined freely as required, and in addition to the standard printer interface, RS-232C interface, barcode reader interface, system bus and a variety of optional communications interfaces are available, providing the PX-16 with unsurpassed expansibility.

The PX-16 is more than capable of functioning as the optimum machine in multiple sectors including an online system terminal for distribution, a VAN terminal, or a controller for machine tools in FA applications.

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1.1.2 PX-16 Features

(1) System component type configuration

The PX-16 consists of a base unit which can be combined with a variety of different keyboards, display units and other options to create the system optimum for specific user applications. The keyboards currently available are the standard keyboard (available in multiple language specifications) and the touch-key board, while the display units available are currently the LCD80, LCD80/2 and LCD40. Other cartridges include high-speed printer, ROM cartridge and RAM cartridge. Through the system bus a disk unit supporting connection of a 3.5-inch FDD and a 20MB HDD can be mounted. It is also possible to connect a CRT or a 5.25-inch FDD.

(2) Expansibility

The PX-16 supports all ROM and RAM as disks, and also supports a variety of expansible I/O ports for FDD, printers and barcode readers with BIOS and device drivers. For input, the standard ASCII keyboard is available, as well as keyboards for a range of other languages and a touch-key board. In addition to the LCD80 and LCD40 display devices, touchkeyboard LCD and CRT displays are also supported.

The I/O configuration is highly expansible, with a Centronics-compatible printer interface, an RS-232C serial communications interface and a barcode reader interface provided as standard equipment. Cartridge1 interface will handle the cartridge for a printer cartridge H or other devices, the system bus is designed to support a disk unit, and expansion interfaces support the asynchronous RS board and the development tool. This careful attention to designed-in expansibility makes the PX-16 capable of implementing almost all user requirements easily.

(3) Compact size

The PX-16 provides a range of functions at least the equivalent of a desktop computer, but is only the size of a sheet of typing paper. Compact design means that it doesn't consume valuable desktop space, and doesn't require a special desk...and a special carrying case makes it highly portable. It can be used freely at home, on business trips or on the move.

(4) Compatibility with EPSON PCe and IBM PC/XT

In the standard keyboard, FDD and display unit (640x200 minimum) configuration, the PX-16 implements an environment compatible with the EPSON PCe and IBM PC/XT computers, making it a highly expansible PC compatible portable for the vertical market. The PX-16 BIOS is compatible with that of the EPSON PCe, and uses MS-DOS Version 3.20 as the operating system.

(5) Memory

The PX-16 consists of a 512KB system ROM (including OS and utilities), main RAM expansible to a maximum configuration of 640KB, a RAM disk expansible to a maximum of 768KB, and three ROM sockets capable of mounting up to 512KB (4M bit). In total more than 3MB of memory is supported internally, and all of it is supported as drives by the OS making it possible for the system to compete with desk top computers even without a floppy disk drive. External FDD and HDD can be connected for even more flexibility and higher performance.

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1.1.3 PX-16 Operating System Features

(1) PC compatibility

The PX-16 is only the size of a sheet of typing paper but offers full compatibility with EPSON PCe and IBM PC/XT machines.

(2) ROM DOS

MS-DOS Version 3.20, the current standard OS, is provided as a ROM disk in ROM0 for processing that is simpler and faster than normal desktops accessing MS-DOS stored on floppy media.

(3) HC boot / PC boot

a) HC boot
Starting up MS-DOS from the PX-16 internal system ROM (ROM0) enables the PX-16 to support all EPSON PCe and IBM PC/XT functions supporting with PC boot, and also all exclusive PX-16 functions.

b) PC boot
In the same environment as that of the desktop computer (FDD and display at least 640x200 dot), booting the system up from the FDD allows the PX-16 to be fully compatible with the EPSON PCe and IBM PC/XT. That is, OS stored in the floppy disk is used instead of OS stored in the ROM disk. In this configuration, however, the exclusive PX-16 functions cannot be used.

(4) Functions Supported in HC Boot

The following additional functions can be used when the PX-16 is started up by HC boot.

a) Expansible I/O support
The PX-16 supports all ROM, RAM and connected FDD/HDD as disks. The optional ROM (maximum three) can be supported as a single drive or as maltiple drives, and the RAM and expansion RAM can also be treated as a single drive.

The wide array of expansion I/O for cartridge options, printers and barcode readers are supported by BIOS and device drivers.

b) Multiple language support
The PX-16 can be set to support ASCII, British, French, German, Spanish, Italian, Swiss (French and German), Norwegian, Finnish, Danish, Swedish and Kana (Japanese) character sets through DIP switch settings.

c) Power control
The PX-16 supports the following three power control functions.

Resume mode
When the power is turned off in the resume mode, the system returns to the state it was in at power-off the next time the power is turned on, and processing continues from the point of interruption. There are two ways to enter the resume mode: with the MS-DOS XMODE command, or by INT 18H software interrupt.

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Auto power off function

If there is no key input from the keyboard within the time limit, the machine will turn itself off automatically to conserve power. By pressing the power switch, the PX-16 will be turned on the resume mode. There are two ways to set the auto-power-off time: with the MS-DOS XMODE command, or by INT 18H software interrupt.

Auto backlight off function

If there is no key input from the touch keyboard within the time limit, the EL backlight for the touchboard LCD will be turned off automatically to conserve power. Touching any key (on either the touch keyboard or the numeric key pad) turns the back light on again. There are two ways to set the auto-backlight-off time: with the MS-DOS XMODE command, or by INT 18H software interrupt.

d) Wake function

By setting this function in HC boot, it is possible to generate an interrupt at a preset time (ALARM) or from an external signal (RING) and automatically turn on system power.

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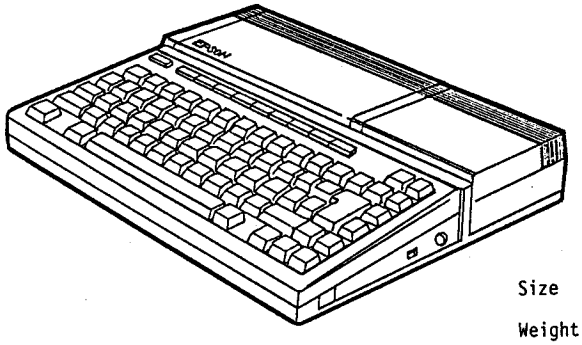
1.2 External appearance

1.2.1 System configurations

It is possible to configure the PX-16 into a variety of different systems by connecting the base unit to different keyboard units, displays and other options. This section introduces the external appearances of a number of the more common system configurations.

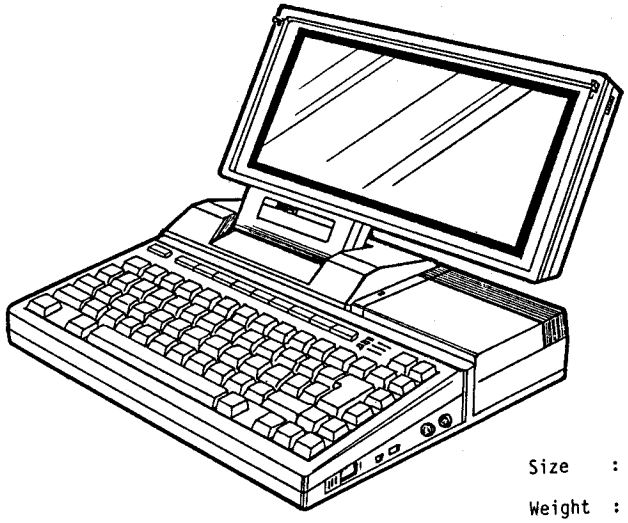
1. Base unit, universal cartridge 2 and standard keyboard



Size : 315mm x 224mm x 47/31.5mm

Weight : Approx. 2.0 kg

2. Base unit, LCD80 and standard keyboard



Size : 315mm x 224mm x 68/31.5mm

Weight : Approx. 2.9 kg

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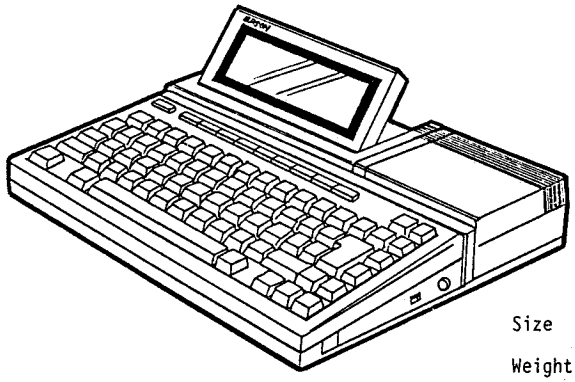
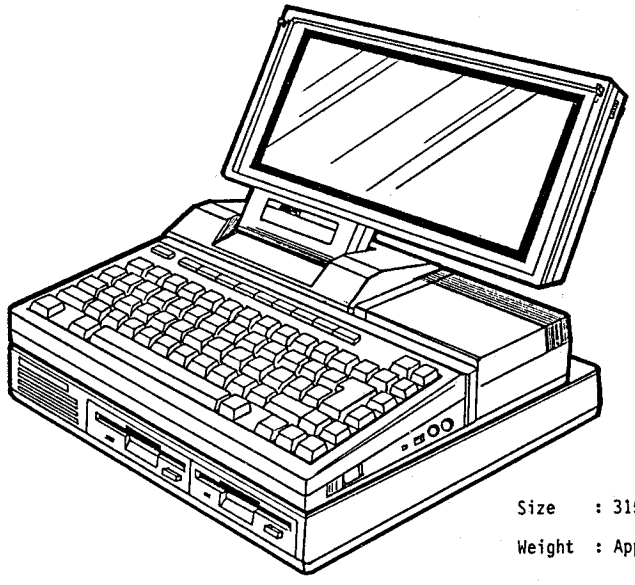
3. Base unit, LCD40 and standard keyboard



Size : 315mm x 224mm x 47/31.5mm

Weight : Approx. 2.1 kg

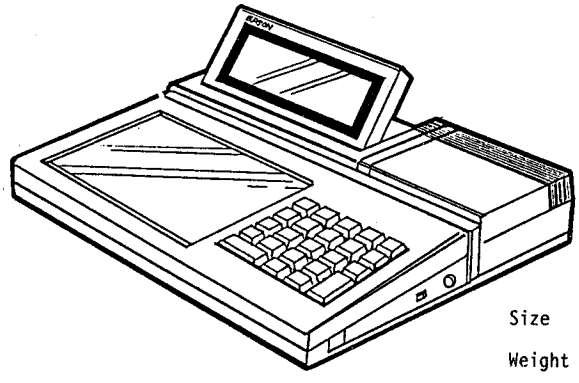
4. Base unit, LCD80, standard keyboard and disk unit



Size : 315mm x 236mm x 116.5/80mm

Weight : Approx. 1FDD 5.5 kg
2FDD 6.1 kg
1FDD and 1HDD 6.6 kg

5. Base unit, LCD40 and touch-key board



Size : 315mm x 224mm x 47/31.5mm

Weight : Approx. 2.2 kg

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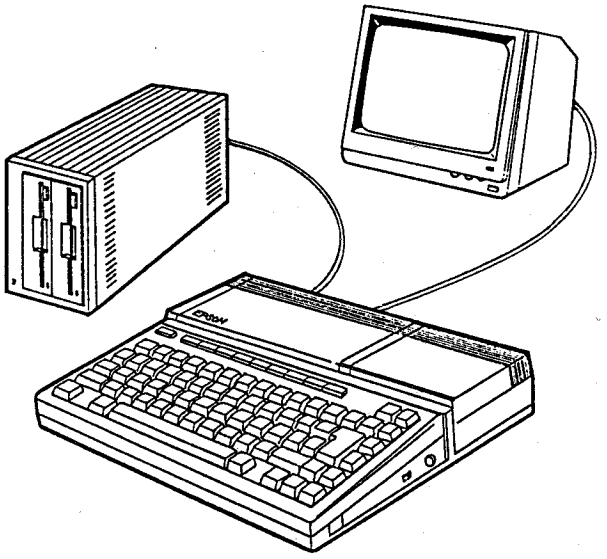
6. Base unit, CRT/FDD cartridge, TF-16 and CRT



Size : 315mm x 224mm x 47/31.5mm (without TF-16, CRT)
Weight : Approx. 2.2 kg (without TF-16, CRT)

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1.2.2 Base unit

The PX-16 base unit has a footprint about the size and shape of a sheet of typing paper, but provides internal support of a variety of functions to make it at least the equal of the EPSON PCe (the EPSON PC-compatible machine). The external appearance of the base unit is detailed below.

(1) Mother board

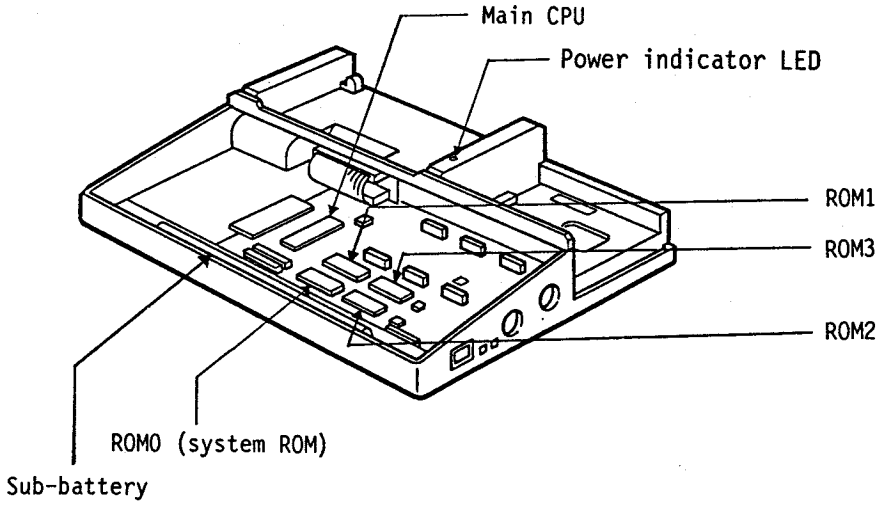

Fig. 1-2-1 Mother Board

(2) Switches

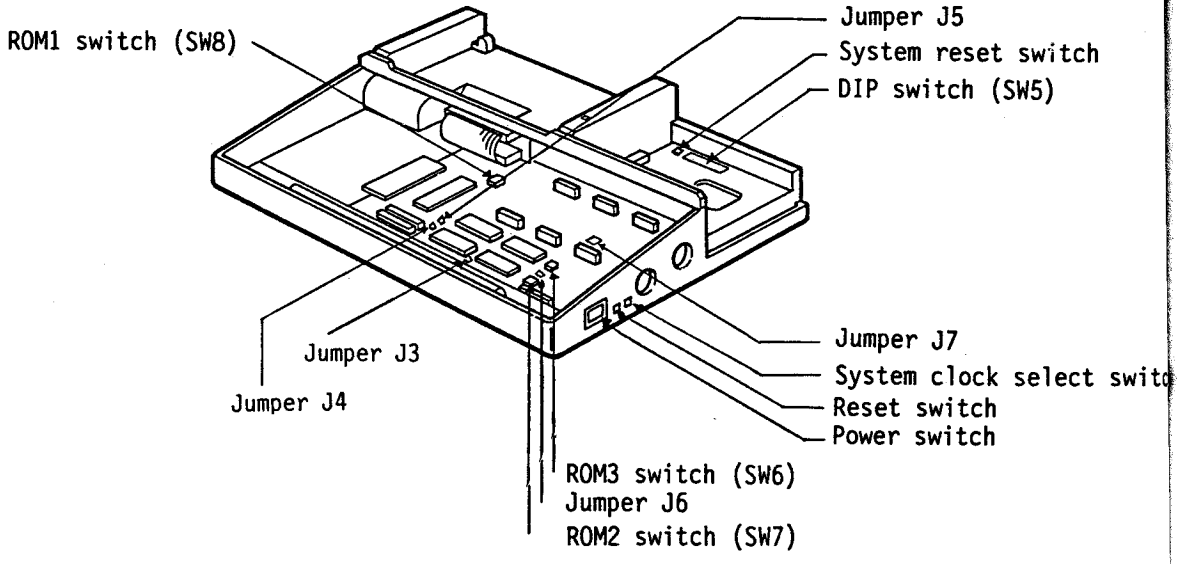

Fig. 1-2-2 Switches

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(3) Interfaces

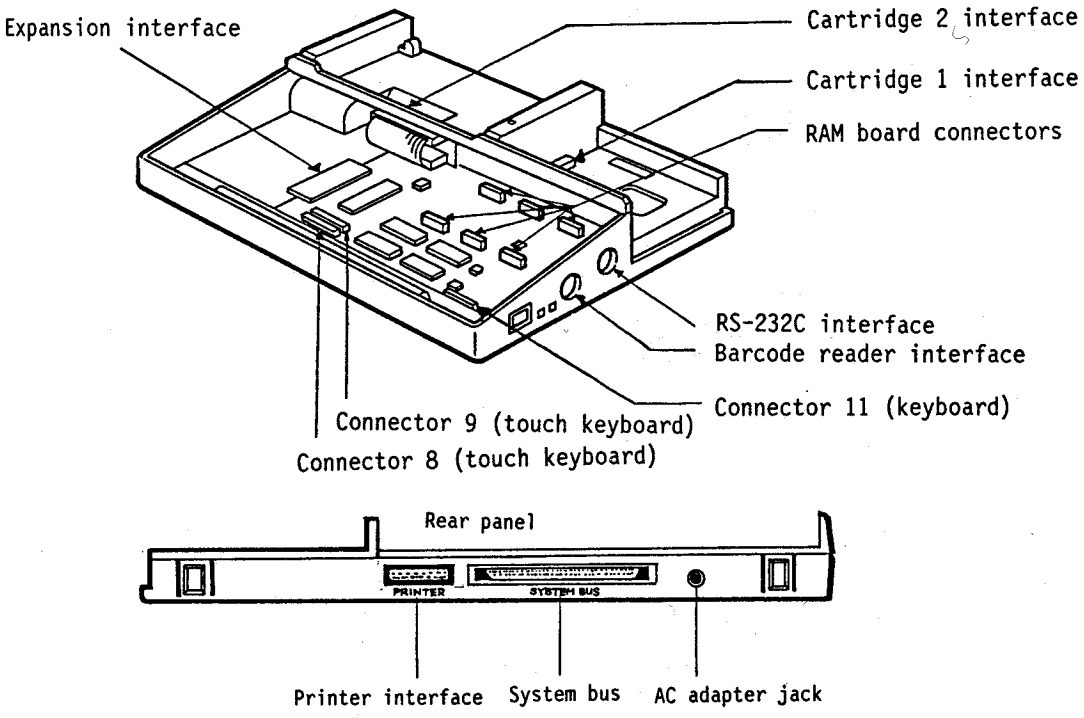

Fig. 1-2-3 Interfaces

(4) Bottom surface

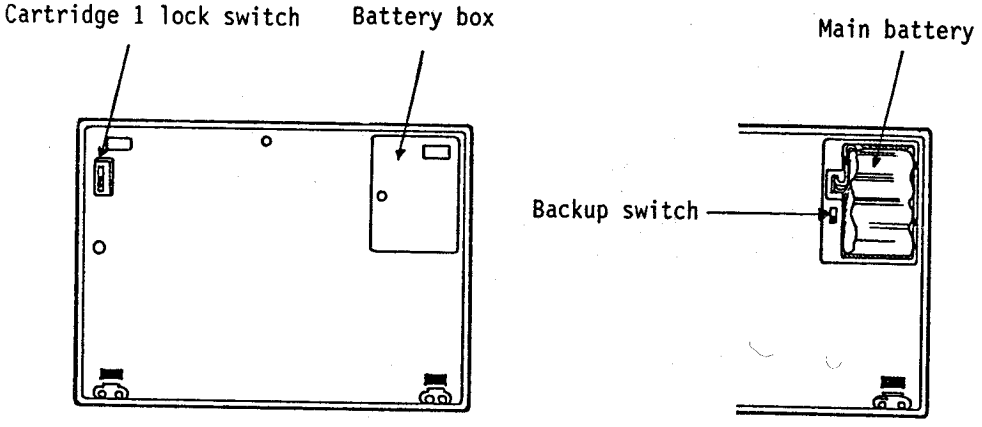

Fig. 1-2-4 Bottom surface

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1.2.3 Options

(1) LCD80, LCD80/2 (connected to the cartridge 2 interface)

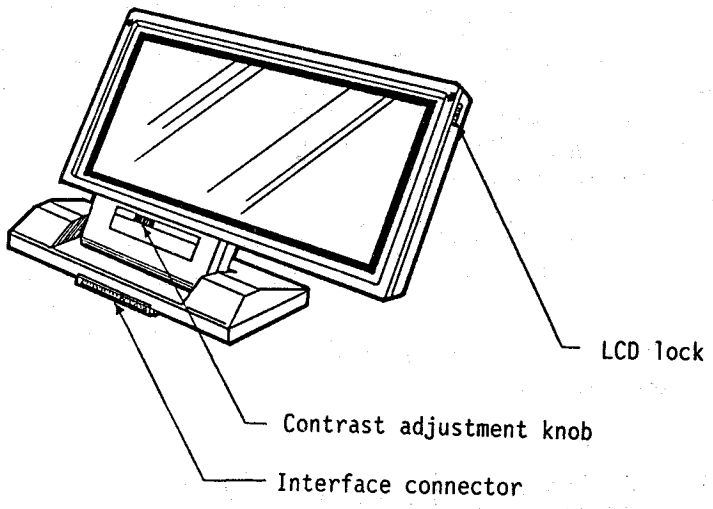

Fig. 1-2-5 LCD80, LCD80/2

Display kind : Super twisted nematic LCD
640 * 200 dot (80 columns * 25 lines)
Duty : 1/200
VRAM : 16K bytes (S-RAM)
Character Generator : Four different kinds
Standard (Light), Bold (Double-width),
Scandinavian, Kana
Other features : Used with color mode
CRT and TF-16 can be connected to LCD80/2

(2) LCD40 (connected to the cartridge 2 interface)

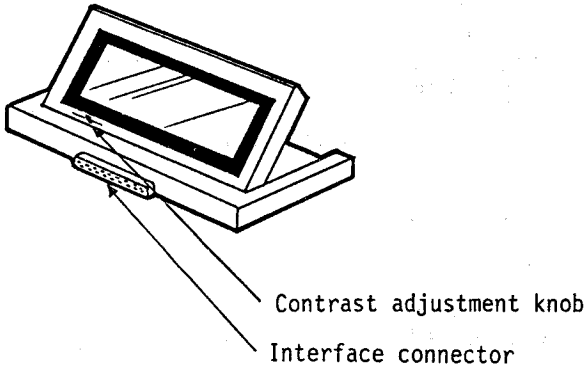

Fig. 1-2-6 LCD40

Display kind : Super twisted nematic LCD
320 * 80 dot (40 colums * 10 lines)
Duty : 1/80
VRAN : BB bytes (S-RAM)
Other features : Tilt adjustment angle

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(3) Standard keyboard (connected to connector 11)

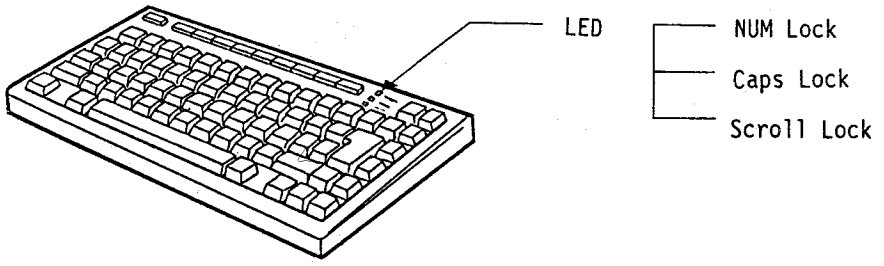

Fig. 1-2-7 Standard keyboard

Features: IBM PC/new XT keyboard compatible

Types: There are nine different types for different countries: ASCII, U.K., France, Germany, Italy, Spain, Swiss, Scandinavian (Sweden/Finland), Kana (Japan)
By changing specific key-tops, the Scandinavian keyboard can be changed to Denmark or Norway.

Number of keys: 78 keys for ASCII / 79 keys for the others

(4) Touchkey board (connected to connectors 8, 9 and 11)

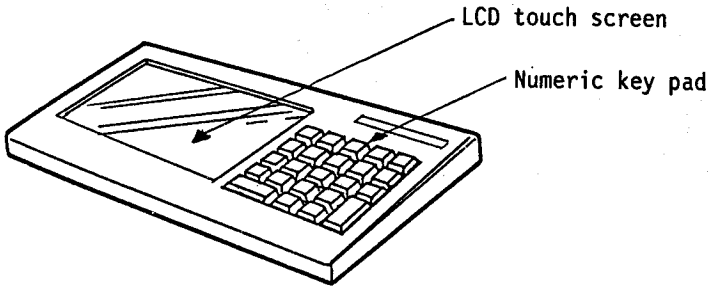

Fig. 1-2-8 Touch keyboard

Features: The LCD touchkey panel allow users to define their own key layouts, as well as providing a responsive and easy-to-use numerical key pad for a dedicated programming machine or other applications.

LCD: The display is a super-twisted nematic LCD semi- transparent EL backlit model, with a 200x88 dot format (25 columns by 8 lines or 11 lines). Duty is 1/88, the VRAM capacity is 8KB (SRAM), and other displays may be used simultaneously.

Touch keys: Reinforced glass, with 12 columns by 8 lines of input locations. Specifications can be made for key definitions, integral displays, and echoback enable/disable.

Numerical key pad: 23 keys (unmarked keys may be marked with labels).

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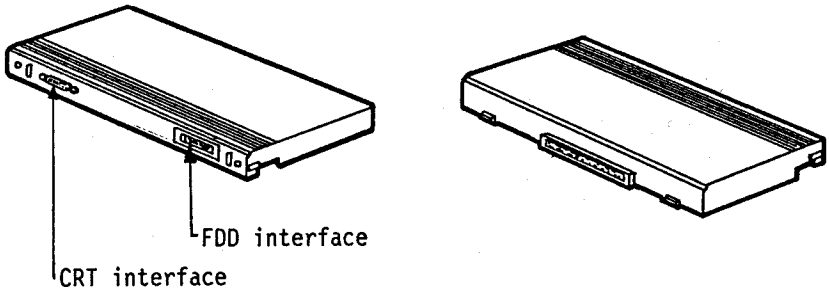
(5) CRT/FDD cartridge (connects to cartridge 2 interface)



1-2-9 CRT/FDD cartridge

Features: Supports connection of a CRT and the TF-16, providing an environment equal to that of the PC.

CRT: Color and monochrome displays designed for the EPSON PC series.

FDD: TF-16 FDD.

(6) Cartridge printer H (connects to cartridge 1 interface)

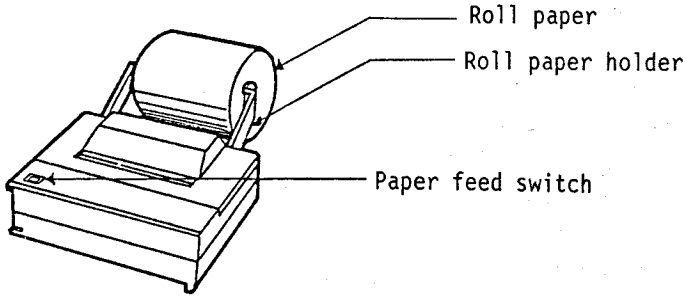


Fig. 1-2-10 Cartridge printer H

Features: Compact, high-speed dot matrix printer fits inside the typing papersize footprint of the base unit.

Columns: 42 columns par line.

Font set: ASCII, Scandinavian.

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(7) Asynchronous RS board (connects to expansion interface)

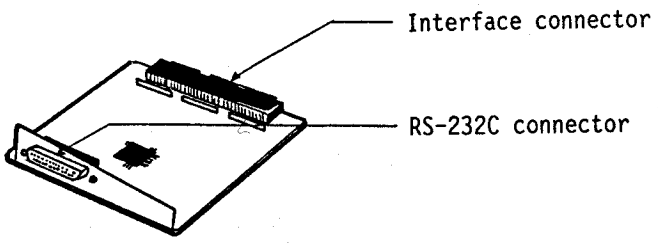

Fig. 1-2-11 Asynchronous RS board

Features: Used as the second serial communications interface, and can also be used as an interface for the development tool.

Communication: Compatible with IBM secondary serial.

Development: The PX-16 exclusive serial port can be used.

(8) 384KB RAM board (connected to RAM board connector)

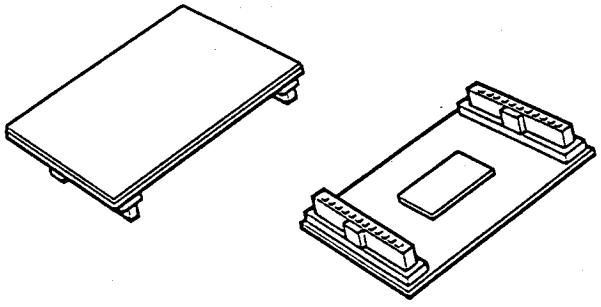

Fig. 1-2-12 384KB RAM board

Features: Expansion RAM board used for expansion of main RAM and RAM disk. Each card mounts 384KB of RAM, and a total of 3 boards may be mounted internally.

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(9) Disk unit (connects to system bus)

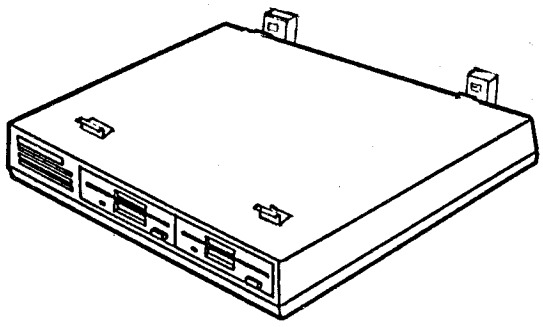

Fig. 1-2-13 Disk unit

Features: Connected to the system bus, and then secured underneath the PX-16 base unit and made integral with it. There are three types, depending on FDD and HDD configuration.

Disk unit 1
- FDD: 3.5-inch (720KB/1.2MB) x one
- HDD: None
- Other: Battery operation possible

Disk unit 2
- FDD: 3.5-inch (720KB/1.2MB) x two
- HDD: None
- Other: Battery operation possible

Disk unit 3
- FDD: 3.5-inch (720KB/1.2MB) x one
- HDD: 3.5-inch HDD (20MB) x one
- Other: AC operation required.

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(10) TF-16 (connects to FDD interface connector)

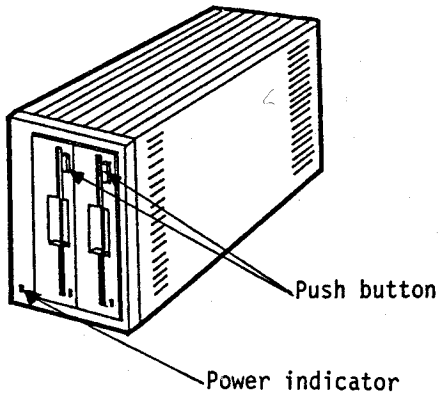

Fig. 1-2-14 TF-16

Features: Connects to CRT/FDD cartridge or LCD-80/2 FDD interface, for use as an external FDD.

FDD: 5.25-inch (360KB) x two

(11) AC adapter

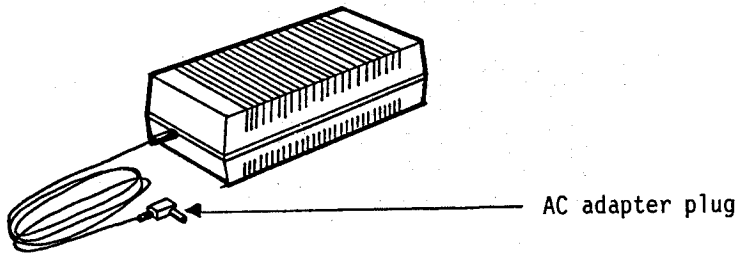

Fig. 1-2-15 AC adapter

Input voltage: 100V~240V
Output voltage: 5.0V
Output current: 4000mAH

(12) Other

Universal cartridges 1 and 2 which permit users to connect their own specific hardware and PX-4 cartridges (ROM cartridge, RAM cartridge) can be connected. A barcode reader and a variety of cables are available as optional equipment.

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1.3 System configuration

1.3.1 Overview

The PX-16 is composed of the base unit mounting the control PCB and power supply, and the keyboard, display unit and cartridges connected to the interfaces. This configuration is indicated below.

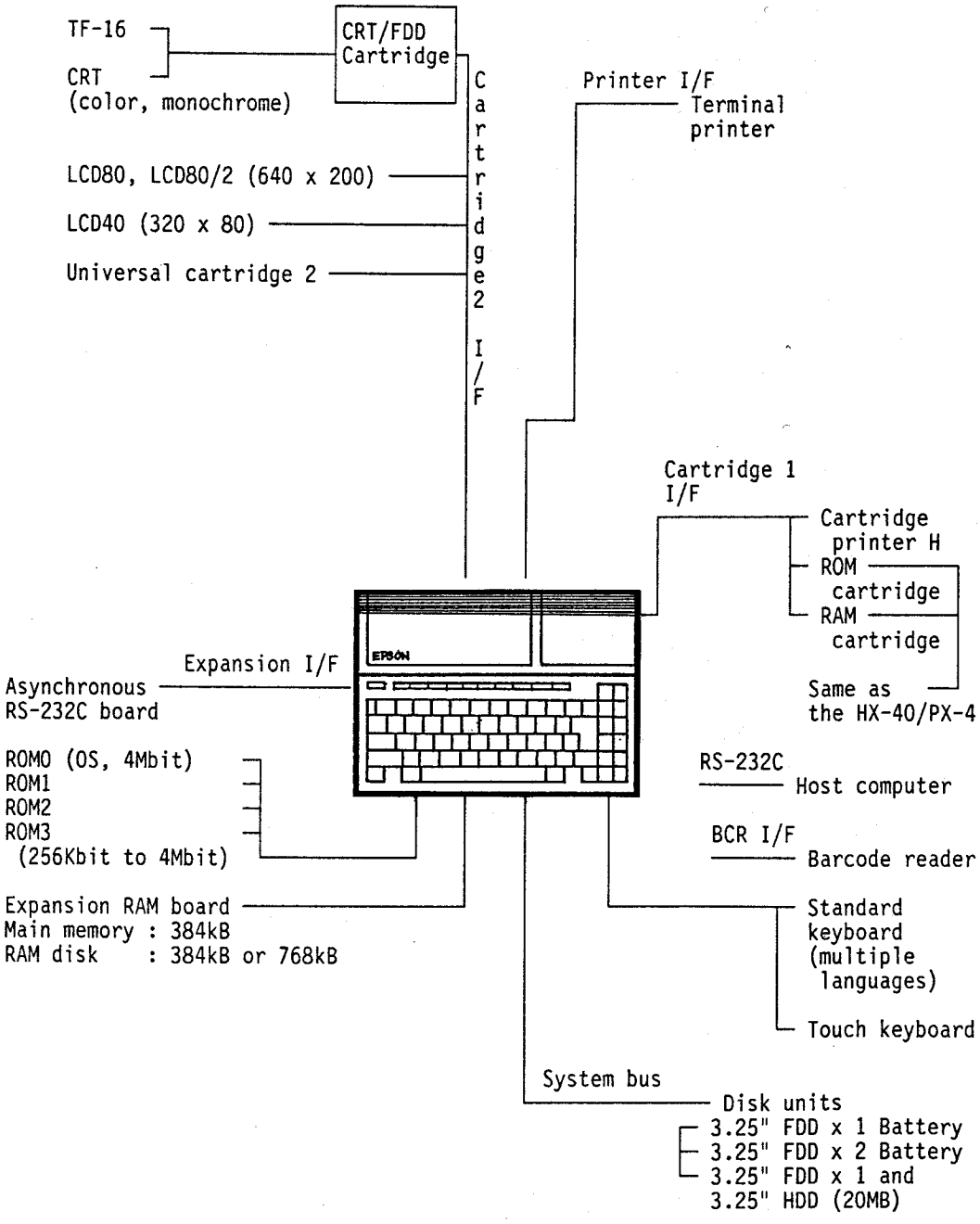

Fig. 1-3-1 System Configuration Diagram

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1.3.2 Hardware configuration

(1) Overview

The PX-16 uses the V20 (a CMOS 8088-compatible) as the main CPU, with switch selection of 4.77 and 10MHz clock speeds.

Memory consists of a maximum of 640KB of main RAM, a maximum of 768KB of RAM disk and a 512KB system ROM (ROM0), all mounted internally, along with three optional ROM slots for applications ROM up to 512KB. This large- capacity memory is supported on the OS as drives. The full utilization of this memory configuration means that the PX-16 offers the performance of an FDD-equipment computer without having to connect external FDD units.

The slave CPU is the 4-bit CMOS 75106, and controls the keyboard, clock and power supply.

The hardware configuration diagram for the PX-16 is given in Fig.1-6.

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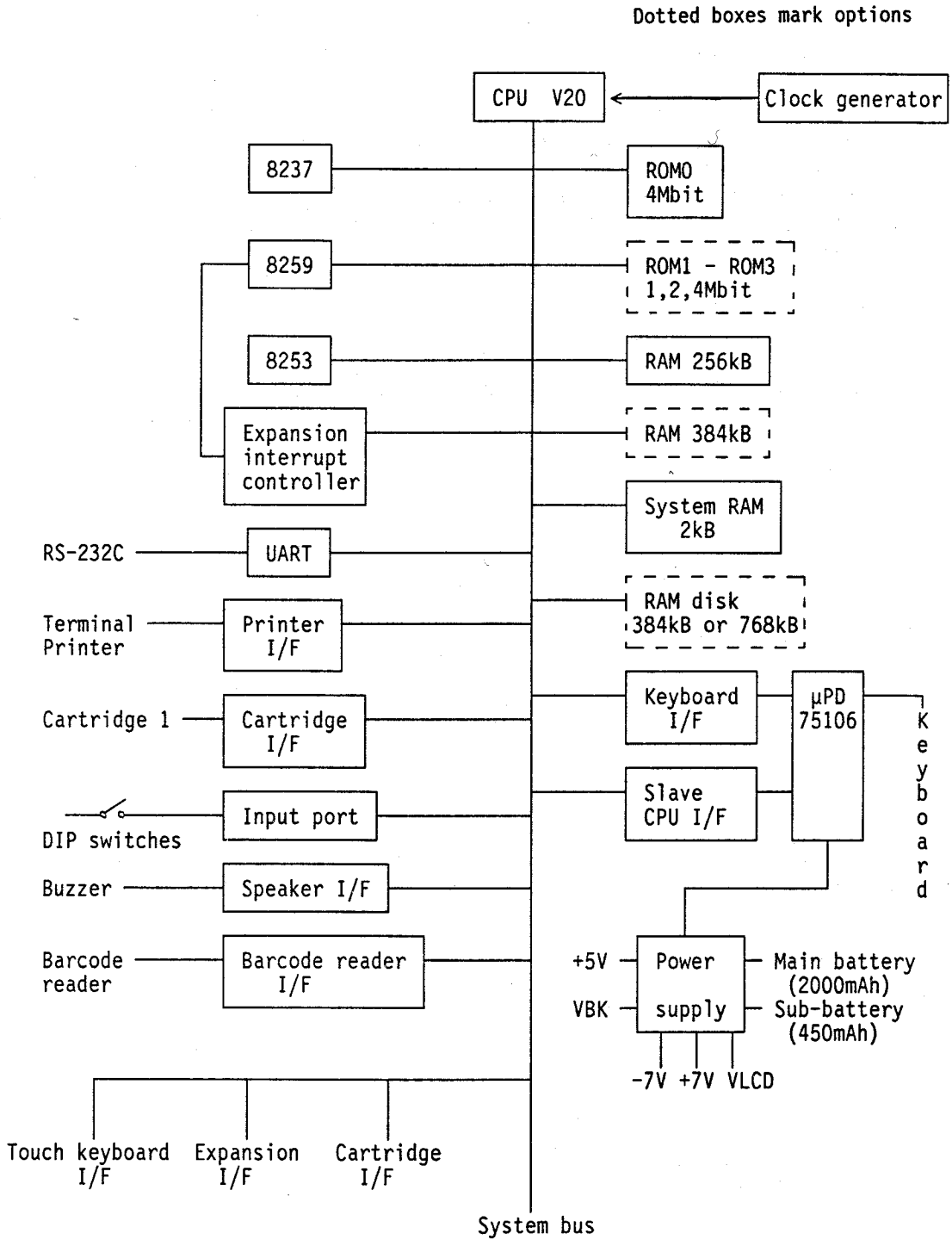

Fig. 1-3-2 Hardware Configuration Diagram

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(2) Hardware details

1) CPU
   a) Main CPU: V20 (switchable to 4.77 or 10MHz)
   b) Slave CPU: 75106 (2.00MHz)

2) RAM
   a) Main RAM: 256KB (expansible to 640KB)
   b) Expansion RAM disk: 768KB
   Expansion is carried out by adding 384KB RAM board.

3) ROM
   a) System ROM: 4Mbit mask ROM (ROM BIOS, MS-DOS, utilities)
   b) Application ROM: 256Kbit to 4 Mbit (maximum of three application ROM chips)

4) Keyboard
   a) Standard keyboard: 78 or 79 keys (Only ASCII is 78 keys). Capability for 12 languages. (ASCII, British, French, German, Spanish, Italian, Swiss (French and German), Norwegian, Finnish, Danish, Swedish and Kana). 3 LED indicators.
   b) Touchkey board: Touch panel: 8x12 input points
      Tenkey pad: 23 keys

5) Displays
   a) CRT: Any display supported by the EPSON PC series. CRT/FDD cartridge or LCD 80/2 is required.
   b) LCD80: 640x200 dots, supports 80 columns x 25 lines or 40 columns x 25 lines.
   c) LCD40: 320x200 dots, supports 40 columns x 10 lines.
   d) Touch LCD: 200x88 dots with EL backlighting, supports 25 columns x 8 lines or 25 columns x 11 lines. The touch LCD is integral with touchkey board.

6) External memory
   a) FDD/HDD: TF-16: 5.25-inch FDD x two, requires CRT/FDD cartridge or LCD 80/2.
      Disk units:3.5-inch FDD x 1, 3.5-inch FDD x 2, or 3.5- inch FDD with 3.5-inch HDD.
   b) Cartridge 1: RAM cartridge (16KB), ROM cartridge (256Kbit x 2).

7) Printers
   a) Parallel: Centronics compatible
   b) Cartridge printer H: Japanese and export specifications, 42-column dot matrix.

8) Serial interface
   a) RS-232C
   b) Expansion interface: asynchronous RS board
   c) Cartridge SIO

9) Other
   a) Cartridge 1: PX-4 cartridges
   b) Barcode: with decoder or without decoder
   c) Buzzer

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1.3.3 Software configuration

(1) Overview

The PX-16 system software is stored in the 4M bit system ROM (ROM0). The system ROM consists of ROM BIOS, MS-DOS, GW-BASIC and standard utilities. In addition, external expansion BIOS, expansion device drivers, and external utilities can be added for as optional utilities (ROM or FDD).

The system ROM configuration is indicated below.

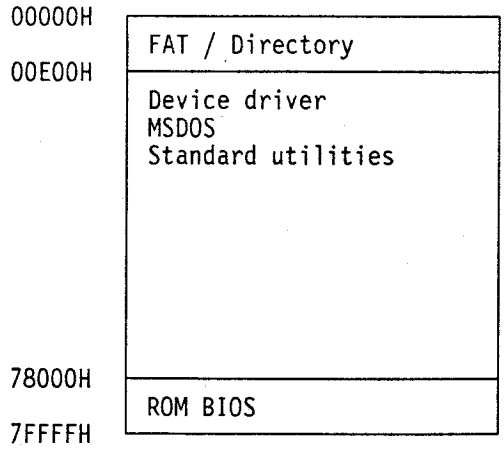

Fig. 1-3-3 System ROM Configuration

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(2) Configuration

The configuration of the PX-16 system software is indicated in Fig. 1-3-4.

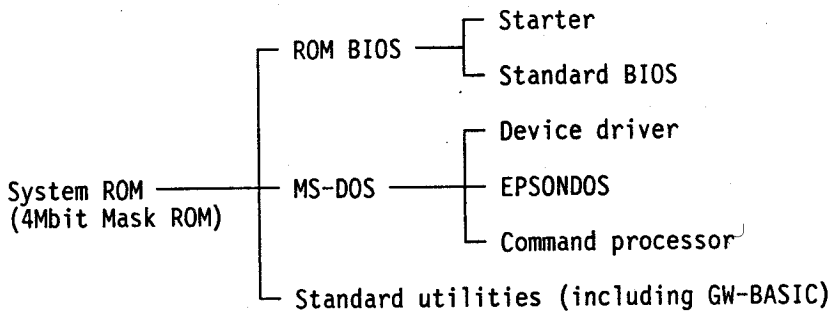

Fig. 1-3-4 System Software Configuration

(3) System ROM overview

1) ROM BIOS

ROM BIOS is stored in 32KB of the system ROM, and consists of a starter and the standard BIOS. The standard BIOS supports all standard PX-16 I/O functions. The starter provides for two boot options, PC boot and HC boot. PC boot supports full EPSON PCe and IBM PC/XT compatibility, while HC boot implements the exclusive PX-16 expansion I/O ports.

2) MS-DOS

The PX-16 OS is MS-DOS Version 3.20, which is stored in the system ROM. The PX-16 includes the standard MS-DOS Version 3.20 expansion functions, such as expansion I/O support through device drivers, boot drive specification with CONFIG.SYS and default drive specification. The MS-DOS used in the PX-16 supports 13 character sets, including ASCII and kana.

3) Utilities

The PX-16 offers standard MS-DOS utilities as well as exclusive utilities designed for the LCD40, barcode readers and so on, all stored in the ROM disk located in the system ROM. GW-BASIC also supports exclusive PX-16 functions and is stored in the ROM disk.

A PROM format specification program and other utilities are available in optional external ROM or floppy media.

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1.4 Memory

1.4.1 Memory configuration

The PX-16 memory consists of the system ROM (4M bit), the main RAM (maximum of 640KB), the RAM disk (maximum of 768KB), and the application ROM (maximum of 3 x 4M bit). The main CPU can directly access 1MB of memory, while the RAM disk (maximum of 768KB) and expansion ROM memory (maximum of 4M bit x 4) is addressed through bank selection.

Normally bank selection is handled by the OS, meaning that applications so not generally require specification. A complete understanding of bank access will make possible application programming on a higher level, however. Refer to Section "3.1 Memory" for concepts of RAM disk and ROM access.

	Standard	Options	Maximum
Main RAM	256 KB	384 KB	640 KB
External RAM disk	0 KB	384 KB x 2	768 KB
System ROM	512 KB	--------	512 KB
Application ROM	None	(32 - 512)KB x 3	1.5 MB

Table 1-4-1 Memory size

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1.4.2 Memory map

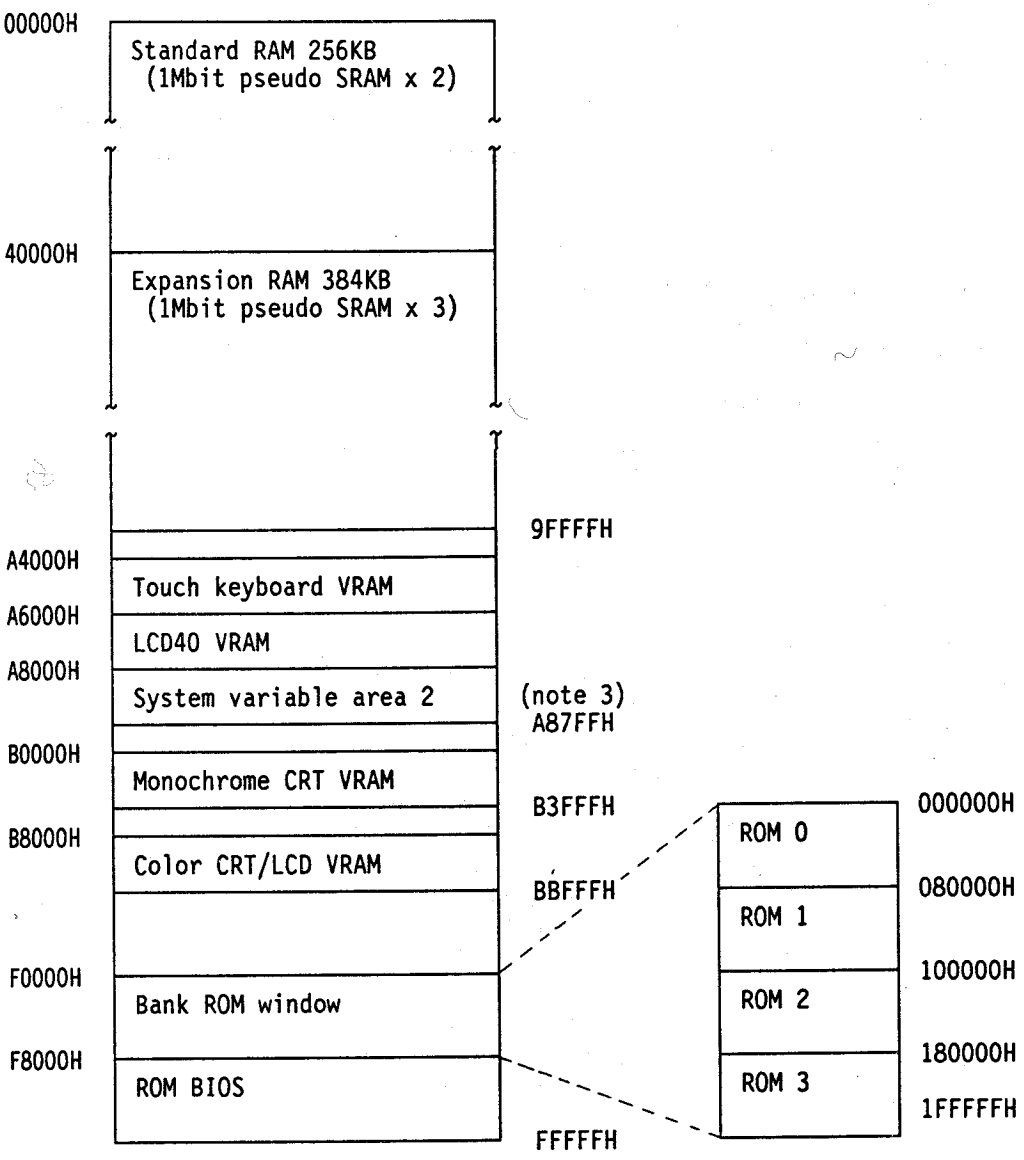

Fig. 1-4-1 Memory map

Note 1: The RAM disk is mapped to the 64KB of continuous free address space from C4000H to EFFFFH.

Note 2: ROM0 through ROM3 are accessed through bank selection, which is handled through the bank ROM window (F0000H~F7FFFH).

Note 3: The system RAM2 only exists in HC boot.

Note 4: The VRAM is mounted on the specific optional cartridge for each display.

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1.5 Power supply

1.5.1 Overview

PX-16 power can be supplied either from the internal NiCd battery pack, or through the AC adapter. Connection of the AC adapter makes operation possible even if the NiCd cells are exhausted.

1.5.2 Power supply specifications

(1) Main battery

NiCd battery: 4.8V, 2000mAH
Recharge current: About 250mA
Recharge time: About 12 hours

(2) Sub battery

NiCd battery: 4.8V, 450mAH
Rechange current: When AC adapter is connected,
Power ON About 20mA
Power OFF About 15mA
When AC adapter is unconnected,
Power ON About 5mA
Power OFF About 0mA
8 hours from system reset switch is pressed
About 60mA
1 hour from power failure is detected
About 60mA
Recharge time: When AC adapter is connected,
Power ON About 34 hours
Power OFF About 45 hours
8 hours from system reset switch is pressed, (Note)
About 16 hours
1 hour from system failure is detected, (Note)
About 25 hours

Note: About 60 mA of recharge current flows for 8 hours after the system reset switch is pressed, or for 1 hour after a power failure occurs. Then the recharge current drops to 25 mA while PX-16's power is on, or to 15 mA while the power is off. Recharging takes the time shown above when the power is off. When the power is on, recharging time is shorter.

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(3) AC adapter

Input voltage:	100~240V
Output voltage:	5.0V
Output current:	4000mAH

(4) Power lines

VB	3~4A	cartridge printer
VBK 1A	backup	
+5V	5mA	system power
+7V	10mA	communications
-7V	10mA	communications
VLCD	5mA	LCD display

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