FRONT

PICTURE 1

March 21, 1990

Part Number 64F3992

Form Number S64F-3992-00

EDITION Edition Notice
Safety Information

Refer to the *Hardware Maintenance Reference General Information* pamphlet in this manual for the following safety information:

- General Safety
- Electrical Safety.

First Edition (March 1990)

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80387SX Intel Corporation

CONTENTS Table of Contents

1.0 Product Description

The IBM (*) Personal System/2 (*) Model 65 SX computers use the IBM Micro Channel (*) architecture. The features of the various types of Model 65 SX are:

- Security: cover lock and power-on password
- System board:
  - 16-MHz 80386SX (**) Microprocessor.
  - 80387SX (**) Math Coprocessor socket.
  - 2MB (MB = 1,048,576 bytes) of random access memory (RAM). The total system memory capacity is 16MB.
  - 64 bytes of complementary metal-oxide semiconductor random access memory (CMOS RAM).
  - Read-only memory basic input/output system (ROM BIOS).
  - Video graphics array (VGA).
  - Eight expansion slots:
    - One auxiliary-video connector
    - One slot occupied by the SCSI Adapter.
  - Serial port.
  - Parallel port.
  - Diskette-drive controller.
  - Keyboard connector.
  - Pointing-device connector.
  - Display connector.
  - Fixed-disk-drive connector.
- Power supply:
  - Automatically switches to the 100-125 Vac or the 200-240 Vac range
  - 50 or 60 Hz
  - 225 watts.
- Speaker
- 101/102-key keyboard
- Fixed disk drives supported (see "Fixed Disk Drives" in topic 2.2).

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Subtopics
1.1 Security
1.2 System-Board Features

1.1 Security

Subtopics
1.1.1 Cover Lock
1.1.2 Power-On Password

1.1.1 Cover Lock

The cover lock is on the left side of the system unit and can be unlocked with the user's key.

If the keys for the cover lock are lost, a new cover-lock assembly can be ordered (see the parts section in the *Hardware Maintenance Service* pamphlet for the model you are servicing). The new assembly contains two keys. Use one of the new keys, along with a pair of pliers to force the old cover lock open.

1.1.2 Power-On Password

A power-on password denies access to the system when the system is powered-on. To service a system with an active and *unknown* power-on password, use the following procedure:

1. Turn off the system unit and all attached options (such as the display and printer).

2. Unplug all computer power cords from electrical outlets.

3. Remove the system-unit cover.

4. If necessary, temporarily remove any long adapters in expansion slots 1 to 4.

   Note: Make a note of which expansion slot you are removing the adapter from and where any cables are attached to the adapter. You will need this information later, when you install the adapters.

5. Locate the speaker connector 1 on the system board.

PICTURE 2

6. Unplug the speaker connector 1, turn it over (180°), and plug it back in.

7. Reinstall any adapters that were removed.

8. Plug in all computer power cords.

9. Power-on the system.

This deactivates the password.

1.2 System-Board Features

The major features of the system board are:

- 80386SX Microprocessor
- CMOS RAM
- CMOS RAM Extension
- ROM BIOS
- VGA
- Serial port
- Parallel port
- Diskette-drive controller
- Keyboard connector
- Pointing-device connector.

Subtopics

1.2.1 Microprocessor

The microprocessor interprets and carries out instructions. The 80386SX Microprocessor is a 32-bit processor with a 16-bit external data bus and operates in two modes: real-address mode and virtual-address (protected) mode. The processor speed is 16 MHz.

1.2.2 CMOS RAM

|The CMOS RAM provides 64 bytes of storage. The first 50 bytes are used to
|store system-configuration and security information. The real-time clock
|uses the remaining 14 bytes to track the date, time, and battery level.

|The data stored in the real-time clock module is kept active by a built-in
|battery. If the battery is depleted, replace the real-time clock module.

1.2.3 CMOS RAM Extension

A 2KB (KB = 1024 bytes) CMOS RAM extension stores additional configuration and system-status information. The data stored in the CMOS RAM extension is kept active by a built-in battery when the system is powered-off. If the stored data is lost due to a depleted or removed battery, the data can be restored using one of the following methods:

- If the user has a customized configuration that uses settings other than the default, run the restore configuration program on the user's backup copy of the Reference Diskette.

- If the configuration uses the default settings, run the automatic configuration program on the Reference Diskette.

1.2.4 ROM BIOS

|ROM BIOS contains the instructions and routines that control the keyboard,
|diskette drives, fixed disk drive, displays, and other major input/output
|devices in the system. Some adapters have their own ROM modules
|containing extended BIOS routines that work with the system-board ROM
|BIOS. The routines for performing the power-on self-test (POST) are also
|contained in the ROM BIOS.

1.2.5 VGA

The VGA is a graphics controller on the system board. The VGA supports color and monochrome analog direct-drive displays in a variety of modes, including alphanumeric text mode, and all-points-addressable (APA) graphics mode.

The VGA supports a maximum of 720-by-400 picture elements (PELs) in the text mode and 640-by-480 PELs in the graphics mode. The VGA can support 256 colors or 64 shades of gray at one time. Composite video is not supported.

One expansion slot on the system board extends farther to the rear of the system board than the others. This extended expansion slot accommodates video adapters that are designed to interface with the system-board VGA. Some of these adapters have a display connector of their own. The extended expansion slot also supports all adapters designed to be installed in the shorter slots.

1.2.6 Serial Port

The serial port is fully programmable and supports asynchronous communications. The 25-pin, D-shell connector provides the signals to drive a device with a standard 25-contact, RS-232 connector. The connected device is identified by the system configuration as either SERIAL 1 or SERIAL 2.

If adapters with serial ports are installed in the system, they can be configured from SERIAL 1 to SERIAL 8. The port on the system board can only be SERIAL 1 to SERIAL 2.

Note: Conflicts occur when using multiple communication lines if two or more lines are addressed the same. Select the **Set configuration** option on the Reference Diskette. Select **View configuration** to verify that no lines are addressed the same.

1.2.7 Parallel Port

The parallel port allows the attachment of devices that accept eight bits of parallel data at standard transistor-transistor-logic (TTL) levels.
|The port has a 25-pin, D-shell connector and is designed primarily for
|printers. However, the port can be used as an input/output port for any
|device or application that matches the input/output capabilities of the
|port. When adapters with additional parallel ports are installed, the
|system can support three different devices, each addressed separately as
|PARALLEL 1, PARALLEL 2, or PARALLEL 3.

Note: Conflicts occur when two or more devices have the same address. Select the **Set configuration** option on the Reference Diskette. Select **View configuration** to verify that no lines are addressed the same.

1.2.8 Diskette-Drive Controller

The controller connects to the diskette drives through a single 40-pin connector on the system board. Signals and voltages are supplied through the diskette-drive cable that plugs into the connector. These signals and voltages can operate two IBM 3.5-inch diskette drives.

1.2.9 Keyboard Connector and Pointing-Device Connector

The two 6-pin connectors at the rear of the system board are for connecting a keyboard and a pointing device (mouse). The keyboard connector is marked with a small keyboard figure molded into the back panel; the unmarked connector is for the pointing device. The interface logic is the same for both. A fuse on the system board protects the system board, keyboard, and pointing device.

2.0 Option Compatibility

The &mod65. uses some adapters designed for Models 50, 60, 70, and 80 computers. For more information, see the parts section in the *Hardware Maintenance Service* pamphlet for the model you are servicing.

Subtopics
2.1 Drive and Diskette Compatibility
2.2 Fixed Disk Drives
2.3 Terminators

2.1 Drive and Diskette Compatibility

The following provides information concerning the identification of diskette drives.

Diskette Drive	**Identifying Mark**
3.5 Inch - 720KB	None
3.5 Inch - 1.44MB	1.44 on the Eject Button

The following addresses the compatibility of diskettes to diskette drives.

Diskette Capacity	**720KB Drive**	**1.44MB Drive**
1.0MB	Read/Write	Read/Write
2.0MB	Not Compatible	Read/Write

Note: For additional information, see "Diskette Drives and Diskettes" in the *IBM Personal System/2 Hardware Maintenance Reference General Information* pamphlet in this manual.

2.2 Fixed Disk Drives

|Model 65 SX systems are shipped with a Small Computer System Interface
|(SCSI) fixed disk drive and adapter. The fixed disk drive and
|fixed-disk-drive interface must be the same. For example, an SCSI adapter
|must be used with an SCSI drive. For supported fixed disk drives, see the
|parts section in the *Hardware Maintenance Service* pamphlet for the model
|you are servicing.

|Model 65 SX fixed disk drives automatically position the read/write heads
|in nondata areas when the system is powered-off. No special precautions
|are required regarding parking the heads when moving the computer.

2.3 Terminators

Diskette Drives: do not use or require terminators.

Fixed Disk Drives: one or more cables are used to connect the fixed-disk adapters to the fixed disk drives. For each cable used, the last drive on the cable must have a terminator.

The location, quantity, and appearance of the terminator may vary from drive to drive. An identification label or tag (usually "T-RES") is attached to the terminator for easy identification.

Note: For additional information, see "SCSI Devices" in the "Options and Adapters (Micro Channel)" section of this manual.

3.0 Operating Requirements

|This section describes the operations that occur from the time the system
|is powered-on until the minimum operating requirements have been met.

Subtopics

3.1 Power Supply

The power supply automatically switches to either the 100-125 Vac or the 200-240 Vac range. The ac input is converted to dc outputs that supply the system with proper operating voltages.

When the system is powered-off for 10 seconds or more and then powered-on, the power supply generates a 'power good' signal that resets system logic. The presence of the 'power good' signal indicates that the power supply is operating properly and that the minimum under-voltage sense levels have been established. This means that all system-board power requirements have been met.

Output (Vdc)	**Minimum Under-Voltage Sense Level (Vdc)**
+ 5.0	+ 4.5
+12.0	+10.8
-12.0	-10.2

The 'power good' signal turns on the green power-good light on the front of the system. If the green light is not on, the power supply is not functioning properly.

3.2 Power-On Self-Test (POST)

|The POST is initiated automatically each time the system power is turned
|on.

|The POST is a series of system checks and initializations that verify the
|correct operation of the system unit. The POST tests only those areas
|that allow the system to be operational enough to run advanced
|diagnostics. The POST can detect two types of errors: critical and
|noncritical.

|*Critical errors* prevent the system from operating or cause incorrect
|results that are apparent to the user. Examples of critical errors
|include microprocessor or interrupt-controller errors. If the POST
|detects a critical error, the microprocessor attempts to display the error
|and all testing stops.

|*Noncritical errors* cause incorrect results that might not be apparent to
|the user. An example of a noncritical error would be a serial
|communications failure. If the POST detects a noncritical error, all
|testing stops and the microprocessor displays an error code. Pressing the
|F1 key allows testing to continue.

|When the Reference Diskette is in drive A, and a noncritical error is
|detected, the system displays the POST error message along with a message
|generated from the Reference Diskette. The Reference Diskette message
|instructs the user to take a specific action to correct the error.

|After a successful POST, one short beep occurs. Control is then given to
|a BIOS routine called the system bootstrap loader. The bootstrap loader
|attempts to load an operating system or a program from either a diskette
|or the fixed disk drive. If neither is present in the system, the Insert
|Diskette icon is displayed (see the *&dia.* pamphlet in this manual). This
|icon indicates that a diskette should be inserted into drive A. After the
|diskette is inserted, press the F1 key to resume operation. If the F1 key
|is pressed when no diskette is in the diskette drive, the IBM Cassette
|BASIC screen appears.

3.3 System Memory

Subtopics
3.3.1 System-Board Memory
3.3.2 Memory-Expansion Adapters
3.3.3 Memory Requirements and Limitations
3.3.4 Memory Errors

3.3.1 System-Board Memory

The Model 65 SX has at least 2MB of memory installed at the time of shipment. An additional memory-module kit can be installed in the second memory-module connector on the system board. The maximum system board memory capacity is 4MB (2MB memory module kits installed in memory-module connector 1 and 2). A memory-module kit must be installed in memory module connector 1. The system can support a total of 16MB of memory.

3.3.2 Memory-Expansion Adapters

Memory-expansion adapters can be installed in any 16-bit expansion slot.

3.3.3 Memory Requirements and Limitations

The system board *does not* have to be fully populated before memory-expansion adapters can be installed, and a memory-expansion adapter *does not* have to filled to capacity before another memory-expansion adapter can be installed.

When memory is added or removed from the system, run the set configuration program on the Reference Diskette.

3.3.4 Memory Errors

The Model 65 SX reallocates system-board memory in 1MB blocks. If the POST detects a memory error in the first 1MB of system-board memory, the entire 1MB of memory is deactivated and an error code is displayed.

4.0 Specifications

Size

- Depth: 482 mm (19 in.)
- Height: 597 mm (23.5 in.)
- Width: 165 mm (6.5 in.)
- Width (feet extended): 318 mm (12.5 in.).

Weight

- Minimum configuration: 21 kg (46 lb)
- Maximum configuration: 26 kg (58 lb).

Environment

- Air Temperature
  - Power on: 10° to 35°C (50° to 90° F)
  - Power off: 10° to 43°C (50° to 110 ° F).
- Humidity
  - Power on: 8% to 80%
  - Power off: 5% to 80%.
- Maximum altitude: 2134 m (7000 ft).

Heat Output

1218 British thermal units (BTUs) per hour (415 watts per hour).

Electrical

- Input voltage (Sinewave input is required)
  - Low Range
    - Minimum: 90 Vac
    - Maximum: 137 Vac.
  - High Range
    - Minimum: 180 Vac
    - Maximum: 265 Vac.
- Input kilovolt-amperes (kVA)
  - Minimum Configuration (as shipped from IBM): Approximately .10 kVA
  - Maximum Configuration: Approximately .54 kVA.

5.0 Special Tools

The following special tools are required to service the Model 65 SX.

Subtopics
5.1 Volt-Ohm Meter
5.2 Wrap Plug

5.1 Volt-Ohm Meter

A meter similar to the Triplett Model 310. (1)

(1) Manufactured by Triplett Corporation, Bluffton, Ohio 45817, U.S.A.

5.2 Wrap Plug

|The Tri-Connector wrap plug (IBM part 72X8546) is used during the advanced
|diagnostic tests of the serial and parallel ports.

|The Tri-Connector wrap plug replaces the following:

|□ (IBM part 8529228) Printer Adapter wrap plug
|□ (IBM part 8286126) Serial Port wrap plug
|□ (IBM part 8529280) Communications Adapter wrap plug
|□ (IBM part 62X1083) Communications wrap plug 25-pin
|□ (IBM part 62X1084) Communications wrap plug 9-pin.

PICTURE 3

6.0 Service Position

The Model 65 SX should be upright when being serviced. If necessary, the unit can be placed on the side without the cover after the feet have been folded.

CAUTION:
The system unit with options may weigh as much as 26 kilograms (58 pounds). Be careful when moving or changing the position of the unit. To ensure general safety, do not attempt to lift any object that you think is too heavy for you.

7.0 Removals and Replacements

|The arrows in the removals and replacements show the direction of movement
|to remove a FRU, to turn a screw, or to press a tab to release the FRU.
|The arrows are marked in numeric order to show the correct sequence of
|removal.

|When other FRUs must be removed prior to removing the failing FRU, they
|are listed at the top of the page. Go to the removal procedure for each
|FRU listed, remove the FRU, and then continue with the removal of the
|failing FRU.

|To replace a FRU, reverse the removal procedure and follow any notes that
|pertain to replacement. See "Locations" for internal cable connection and
|arrangement information.

|CAUTION:
|Before removing any field replaceable unit (FRU), power-off the system,
|unplug all power cords from electrical outlets, and disconnect any
|interconnecting cables.

|Warning: The system board, adapters, memory modules, and the math
|coprocessor are sensitive to, and can be damaged by, electrostatic
|discharge. Establish personal grounding by touching a ground point with
|one hand before touching these units.

|**Note:** An electrostatic discharge (ESD) strap may be used to establish
| personal grounding.

Subtopics

7.1 1005 Cover

CAUTION:
Before removing any FRU, power off the system, unplug all power cords from electrical outlets, and disconnect any interconnecting cables.

PICTURE 4

7.2 1010 Cover Lock

- Cover **(1005)**

PICTURE 5

7.3 1015 Adapters

- Cover **(1005)**
- Disconnect any cables attached to the adapter.

|**Note:** Before replacing an adapter, note the locations of the adapter and
| cables. When replacing an adapter, install the replacement adapter
| in the same slot as the adapter that was removed.

| Stored configuration information depends on the location of the
| adapter. If the replacement adapter is installed in a different
| location, run the set configuration program on the user's Reference
| Diskette to reset the system-configuration information.

PICTURE 6

7.4 1020 Math Coprocessor

- Cover **(1005)**
- Remove adapters **(1015)** that are in the way.

Warning: Remove the math coprocessor carefully. Do not bend the pins when removing the math coprocessor. The math coprocessor can be damaged by electrostatic discharge, prying between the module and connector, or prying between the connector and system board. Establish personal grounding by touching a ground point with one hand before touching the math coprocessor.

The system will not operate properly if the math coprocessor is not installed correctly or is the wrong type for the system.

Note: The Model 65 SX uses a 16-MHz 80387SX Math Coprocessor. When replacing the math coprocessor, make sure the dot on the coprocessor is aligned with the dot on the system board.

PICTURE 7

7.5 1025 Speaker Assembly

- Cover **(1005)**

PICTURE 8

7.6 1030 Feet

- Cover **(1005)**
- Remove any adapters **(1015)** that are in the way.

PICTURE 9

7.7 1035 Front Bezel

PICTURE 10

7.8 1040 Carrying Handle

- Front bezel **(1035)**

PICTURE 11

7.9 1045 Power Supply

- Cover **(1005)**
- Front bezel **(1035)**.

Note: Disconnect all cables from the power supply.

PICTURE 12

7.10 1050 Diskette Drive

- Cover **(1005)**
- Front bezel **(1035)**.

Note: Some models require that you unplug the diskette-drive cable before removing the drive.

PICTURE 13

7.11 1055 Diskette Drive Support Structure

- Cover **(1005)**
- Front bezel **(1035)**
- Diskette drive **(1050)**.

PICTURE 14

7.12 1060 Fixed Disk Drive (Front Bay)

Warning: Improper shipping and handling can result in permanent loss of all data and formatting on the fixed disk drive. Have the user back up all information from the fixed disk drive.

- Cover **(1005)**
- Front bezel **(1035)**.

Notes:

1. Remove the terminator on the fixed disk drive in the front bay.

2. See "Locations" for cable connection information.

3. When installing SCSI fixed disk drives, refer to "SCSI Devices" in the "Options and Adapters (Micro Channel)" section of this manual.

4. Disconnect any ground wires and cables from the fixed disk drive.

PICTURE 15

7.13 1065 Fixed Disk Drive (Rear Bay)

Warning: Improper shipping and handling can result in permanent loss of all data and formatting on the fixed disk drive. Have the user back up all information from the fixed disk drive.

- Cover **(1005)**
- Fixed disk drive (front bay), if installed **(1060)**

Notes:

1. Disconnect any ground wires and cables from the fixed disk drive.

2. The fixed disk drive in the rear bay must have the terminator installed. Some systems may have two SCSI fixed disk drives in the rear bay. On those models, the terminator must be installed on the drive closest to the system board. For more information, refer to "SCSI Devices" in the "Options and Adapters (Micro Channel)" section of this manual.

3. See "Locations" for cable connection and arrangement information.

PICTURE 16

7.14 1070 Fixed Disk Drive Bracket

Notes:

1. Some systems may have one or two fixed disk drives mounted in a bracket.

2. Remove the fixed disk drive cable from the cable strap if necessary.

3. Two screws on each side (one drive).

4. Four screws on each side (two drives).

PICTURE 17

7.15 1075 Fixed Disk Drive Support Structure

- Cover **(1005)**
- Fixed disk drive (front bay), if installed **(1060)**
- Fixed disk drive (rear bay) **(1065)**.

PICTURE 18

7.16 1080 Memory-Module Kits

- Cover **(1005)**
- Fixed disk drive (front bay), if installed **(1060)**
- Fixed disk drive (rear bay), if removing the kit in the left connector **(1065)**
- Fixed disk drive support structure, if removing the kit in the left connector **(1075)**.

Note: When servicing the two side-by-side memory-module kits, remove the kit in the connector on the right before attempting to remove the kit in the connector on the left. A memory-module kit must be installed in the connector on the left.

PICTURE 19

7.17 1085 System Board

- Cover **(1005)**
- Adapters **(1015)**
- Math coprocessor, if installed **(1020)**
- Front or rear fixed disk drives, **(1060)(1065)**
- Fixed-disk-drive support structure **(1075)**
- Memory-module kits **(1080)**.

Notes:

1. Disconnect all cables from the system board.

2. When a new system board is installed, run "Restore configuration," using the user's Reference Diskette to restore any unique configuration data. To reset the date and time, run the "Set Features" utility.

PICTURE 20

7.18 1090 Fixed Disk Drive Support Structure Bracket

- Cover **(1005)**
- Adapters **(1015)**
- Front bezel **(1035)**
- Power supply **(1045)**
- Front or rear fixed disk drives, **(1060)(1065)**
- Fixed disk drive support structure **(1070)**
- System board **(1085)**.

Note: When you remove the four screws that hold the bracket, the labels on the outside of the system will be destroyed. Replace these labels with new labels after reassembly. See the parts section in the *Hardware Maintenance Service* pamphlet for the system you are servicing).

PICTURE 21

8.0 Locations

Subtopics
8.1 Front View
8.2 Rear View
8.3 Interior View
8.4 Internal Cables
8.5 System Board

8.1 Front View

1 Carrying handle
2 Cover lock
3 Power-good light
4 Fixed disk drive in-use light
5 Power switch
6 Diskette drive in-use light
7 Diskette drive A
8 Diskette eject button
9 Diskette drive B (if installed)
10 Serial number.

PICTURE 22

8.2 Rear View

1 Power cord connector
2 Keyboard connector
3 Pointing-device connector
4 Parallel port
5 Serial port
6 Display connector
7 SCSI connector (some models)
8 Expansion slots.

PICTURE 23

8.3 Interior View

1 Power supply
2 Diskette drive A
3 Diskette drive B (if installed)
4 Front-bay fixed disk drives (if installed)
5 Speaker assembly
6 Expansion slots (numbered from bottom, 1 to 8)
7 Rear-bay fixed disk drive
8 Power-supply connectors.

PICTURE 24

8.4 Internal Cables

This diagram shows the arrangement of the cables that connect the various devices.

1 Power supply
2 Fixed disk drive (rear bay)
3 Fixed disk drive (front bay)
4 Diskette drive A
5 Diskette drive B
6 System board
7 Speaker
8 SCSI cable
9 SCSI adapter.

PICTURE 25

8.5 System Board

1 Fuse
2 Power-supply connector
3 Real-time clock module connector
4 2KB CMOS RAM extension module connector
5 Diskette drive connector
6 Memory-module-kit connectors
7 80387SX Math Coprocessor socket
8 Speaker assembly connector
9 16-bit expansion slot
10 Video slot (slot 6)
11 Display connector
12 Serial connector
13 Parallel connector
14 Pointing-device connector
15 Keyboard connector.

PICTURE 26

9.0 Safety Grounds

| 1 Power-cord connector
| 2 Primary ground
| 3 Chassis ground
| 4 Expansion-slot screws
| 5 Screws.

PICTURE 27

Notes: