FRONT

PICTURE 1

March 21, 1990

Part Number 64F3985

Form Number S64F-3985-00

PICTURE 1

FRONT_1 Safety Information

Refer to the *Hardware Maintenance Reference General Information* pamphlet
for the following information:

    General Safety
    Electrical Safety.

First Edition (March 1990)

FRONT_2 Special Notices

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1.0 Introduction to Diagnostics

This pamphlet provides diagnostic information for IBM (*) Personal
System/2 (*) non-Micro Channel computers (for example Models 25 and 30).
For diagnostic information about Micro Channel (*) computers (for example,
Models 50, 60, 70, and 80), refer to the *Diagnostic Information for Micro
Channel Computers* pamphlet.

2.0 Diagnostic Aids

This section provides an introduction to the diagnostic service aids and
how they work together to solve problems. It will serve as a useful
reference until you become familiar with the diagnostic aids.

The diagnostic aids in isolating a failing field replaceable unit (FRU)
are:

    Power-On Self-Test (POST)
    Advanced Diagnostic Tests on the Advanced Diagnostics Diskette
    Hardware Maintenance Service pamphlets.

The display screen drawings shown in this pamphlet are intended to be
representative rather than exact. The shapes of characters on your
display screen may appear slightly different from those shown.

When instructed to "Power-on the system," switch on the power to all
externally attached devices (such as displays, printers, or plotters)
before switching on power to the system unit.

When instructed to "Power-off the system," switch off the power to all
externally attached devices and then power to the system unit.

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    the International Business Machines Corporation.

3.0 Power-On Self-Test (POST)

The POST is initiated each time you power-on the system and takes up to 90
seconds to complete, depending on the options installed.

The POST checks the following:

    System Board
    Memory
    Video Interface
    Keyboard
    Diskette Drive
    Fixed Disk Drive
    Serial and Parallel Ports.

To start the POST, power-on the system. The following occurs:

1. While the memory is tested, the memory size is displayed in the
    top-left corner of the screen and increases in 64KB increments until
    the total system memory is tested.

2. One short beep sounds when the POST has successfully completed.

3. The system attempts to load an operating system. If an operating
    system is not found either in diskette drive A or on fixed disk drive
    C (if installed), an icon is displayed requesting the user to insert a
    diskette into drive A and press the **F1** key to resume operation.

If the POST cannot be completed successfully, an error message is
displayed accompanied by the **(RESUME = "F1" KEY)** icon, requesting the user
to press the **F1** key. When the F1 key is pressed, the system unit bypasses
the error and attempts to complete the POST. If a critical error is
encountered, the POST stops.

4.0 Icons

The following graphic messages (icons) request the user to take a specific
action.

Subtopics
4.1 Set Time and Date
4.2 Press F1 to Continue
4.3 Insert a Diskette
4.4 Non-loadable Diskette
4.5 Power-On Password

4.1 Set Time and Date

PICTURE 2

This icon requests the user to run the "Set Time and Date" program from
either the Advanced Diagnostics diskette or the Customer Diagnostics
diskette. The real-time clock memory is checked each time the system is
powered on. If the memory is found to be empty, the POST generates this
icon. Conditions that may cause this problem are:

    Initial install, date and time have not been set.

    The bus adapter has been removed from the system, causing the
    real-time clock memory to be lost.

    A defective bus adapter is not able to keep the real-time clock memory
    active.

This icon is accompanied by the instruction **(RESUME = "F1" KEY)**. The user
has two alternatives:

    Insert the diagnostic diskette into diskette drive A, press the **F1**
    key, and run the Set Time and Date program.

    Press the **F1** and bypass the error.

4.2 Press F1 to Continue

PICTURE 3

The "Press F1 to Continue" icon is displayed with other icons. The user
is advised that an action is required. Pressing the **F1** key allows the
system to resume its operation. The service pamphlet refers to this icon
as the (RESUME ="F1" KEY) message.

4.3 Insert a Diskette

PICTURE 4

Each time the system is powered on or a system reset is performed, the
system looks for an operating system. If the operating system is not
found, this icon is displayed. It instructs the user to insert a diskette
containing the operating system into diskette drive A, then press the **F1**
key to resume operation.

If the **F1** key is pressed prior to inserting the diskette, the system
automatically loads BASIC from the ROM BIOS.

4.4 Non-loadable Diskette

PICTURE 5

Each time the system is powered on or a system reset is performed, the
system checks diskette drive A to see if a diskette is installed. If a
formatted diskette is installed but does not contain an executable
program, this icon is displayed for several seconds and is then replaced
by the "Insert a Diskette" icon.

4.5 Power-On Password

The power-on password icon is a small key that is displayed on the screen
each time the system (not all non-Micro Channel systems) is powered-on
with the password option set. The user is required to type the password to
access the system (the password is not displayed as it is typed). The
system cannot be used until the password is entered.

PICTURE 6

To service a system with an active, unknown power-on password, power-off
the system. Move jumper J13, on the system board, from its current
position (pins 1 and 2 or pins 2 and 3) to the alternate position (pin 2
and the present unused pin); then power-on the system. This disables the
password portion of CMOS RAM. The jumper can be left in this position
after service is completed.

Note: If a password is malfunctioning or cannot be disabled, the system
board must be replaced.

The user must reinstall the password after service. To reinstall the
password, have the user start the Starter diskette, select **Set features**
from the main menu, and follow the instructions on the screen.

5.0 Advanced Diagnostics Diskette

The Advanced Diagnostics diskette contains diagnostic and utility programs
that aid in FRU isolation and system service. Backup your Advanced
Diagnostics diskette (see "Utilities" on page 5.3), store the original,
and use the copy.

Note: Depending on the PS/2 model, the diagnostic menus on Advanced
        Diagnostics diskettes may vary. For example, the "Setup
        Configuration" menu appears only on diskettes with a setup program.

Subtopics
5.1 Special Keys
5.2 Diagnostic Menus
5.3 Utilities
5.4 Setup Program

5.1 Special Keys

The following keys and key combinations have special functions for the
advanced diagnostic tests:

Key   **Use**

F1   Forces the system unit to bypass a non-critical error and
                 continue with the POST.

Ctrl + P   Directs screen output to the printer.

Ctrl + N   Cancels output to the printer.

Ctrl + C   Stops diagnostic tests and returns to the Installed Devices
                 menu.

Print Screen Prints what is on the screen (useful when the display is
                 unreadable).

5.1 Special Keys

The following keys and key combinations have special functions for the
advanced diagnostic tests:

Key   **Use**

5.2 Diagnostic Menus

The following menus are available on the Advanced Diagnostics diskette.

Subtopics
5.2.1 Diskette Diagnostic
5.2.2 Fixed Disk Diagnostic
5.2.3 Video Graphics Array
5.2.4 Video Test

5.2.1 Diskette Diagnostic

This menu allows you to test the diskette drives and the control logic on
the system board.

```
+------------------------------------------------------------------------------+
¦                                                                              ¦
¦                                                                              ¦
¦ TESTING -                                                                    ¦
¦ X DISKETTE DRIVE(S)                                                          ¦
¦ DISKETTE DIAGNOSTIC MENU                                                     ¦
¦ ----------------------------                                                 ¦
¦ OPTION                                                                       ¦
¦  1 - SEEK TEST                                                               ¦
¦  2 - WRITE, READ, COMPARE TEST                                              ¦
¦  3 - VERIFY DISKETTE TEST                                                   ¦
¦  4 - SPEED TEST                                                             ¦
¦  5 - DISKETTE CHANGE TEST                                                   ¦
¦  9 - RETURN TO CONTROL PROGRAM                                             ¦
¦                                                                              ¦
¦                                                                              ¦
¦                                                                              ¦
¦                                                                              ¦
+------------------------------------------------------------------------------+
```

1 - SEEK TEST: Tests the basic diskette seek operations, including
sequential and random diskette-drive head positioning.

2 - WRITE, READ, COMPARE TEST: Tests the basic diskette operations,
including a series of random seeks, each seek being followed by a write,
read, and comparison of data.

3 - VERIFY DISKETTE TEST: Verifies data-accessing and each sector on the
diskette.

4 - SPEED TEST: Measures the time required for one revolution of the
diskette.

5 - DISKETTE CHANGE TEST: Tests the diskette change signal and
write-protect feature as you remove and insert a diskette.

9 - RETURN TO CONTROL PROGRAM: Returns to the System Checkout menu.

5.2.2 Fixed Disk Diagnostic

This menu allows you to test the fixed disk drive and the integrated
controller.

```
+------------------------------------------------------------------------------+
¦                                                                              ¦
¦                                                                              ¦
¦                                                                              ¦
¦                                                                              ¦
¦ FIXED DISK DIAGNOSTIC MENU                                                    ¦
¦ --------------------------                                                    ¦
¦  1 - WRITE, READ, COMPARE (ON TEST CYLINDER)                                  ¦
¦  2 - SEEK TEST                                                               ¦
¦  3 - HEAD SELECT                                                             ¦
¦  4 - ERROR DETECTION AND CORRECTION                                          ¦
¦  5 - RUN ALL TESTS                                                          ¦
¦  6 - READ VERIFY                                                             ¦
¦  7 - FORMAT MENU                                                             ¦
¦  9 - RETURN TO CONTROL PROGRAM                                               ¦
¦                                                                              ¦
¦                                                                              ¦
¦                                                                              ¦
+------------------------------------------------------------------------------+
```

1 - WRITE, READ, COMPARE (ON TEST CYLINDER): Tests the write and read
operations.

2 - SEEK TEST: Sequentially moves the heads inward one cylinder at a time
until the last cylinder is reached. The heads then reset to the first
cylinder and a random seek test is performed.

3 - HEAD SELECT: Writes data to the test cylinder using each head. The
data is then read and checked for any errors.

4 - ERROR DETECTION AND CORRECTION: Reads data, alters the data, and
writes the data at the test cylinder. A comparison test is made to detect
any errors.

5 - RUN ALL TESTS: Runs tests 1 through 4.

6 - READ VERIFY: Reads the entire fixed disk drive and reports any
existing defects and tracks that cannot be read.

7 - FORMAT MENU: Selects the Format Selection menu.

9 - RETURN TO CONTROL PROGRAM: Returns to the System Checkout menu.

5.2.3 Video Graphics Array

This menu allows you to test the display and the control logic on the
system board.

```
+------------------------------------------------------------------------------+
¦                                                                              ¦
¦                                                                              ¦
¦                                                                              ¦
¦                                                                              ¦
¦ VIDEO GRAPHICS ARRAY                                                         ¦
¦                                                                              ¦
¦  1 - VGA TEST                                                                ¦
¦  2 - DISPLAY ATTRIBUTES                                                      ¦
¦  3 - CHARACTER TESTS                                                         ¦
¦  4 - GRAPHICS TESTS                                                          ¦
¦  5 - SCREEN PAGING                                                           ¦
¦  6 - RUN TESTS 1 THROUGH 5                                                   ¦
¦  7 - SYNC TEST                                                               ¦
¦  9 - EXIT TO MAIN MENU                                                       ¦
¦                                                                              ¦
¦                                                                              ¦
¦                                                                              ¦
¦                                                                              ¦
+------------------------------------------------------------------------------+
```

1 - VGA TEST: Verifies the video portion of the system board.

2 - DISPLAY ATTRIBUTES: Shows the following character attributes: normal
and high intensity, reverse video, blinking, non-display, and 16 colors
(color displays only).

3 - CHARACTER TESTS: Shows the following character modes: 40x25, 80x25,
80x30, and 256 ASCII characters.

4 - GRAPHICS TESTS: Displays various patterns to test the display
graphics modes.

5 - SCREEN PAGING: Tests the video-addressing circuitry.

6 - RUN TESTS 1 THROUGH 5: Performs tests 1 through 5.

7 - SYNC TEST: Provides a test signal to allow voltage measurements at
the video connector.

9 - EXIT TO MAIN MENU: Returns to the System Checkout menu or continues
with the next device test.

5.2.4 Video Test

This menu allows you to test the display and the control logic on the
system board.

```
+-------------------------------------------------------------------------------+
¦                                                                               ¦
¦                                                                               ¦
¦ DISPLAY TEST                                                                   ¦
¦                                                                               ¦
¦  0 - DISPLAY SELF TEST                                                         ¦
¦  1 - DISPLAY ATTRIBUTES                                                        ¦
¦  2 - CHARACTER SET                                                             ¦
¦  3 - 80X25 DISPLAY                                                             ¦
¦  4 - 40X25 DISPLAY                                                             ¦
¦  5 - 320X200 GRAPHICS                                                          ¦
¦  6 - 640X200 AND 640X480 GRAPHICS                                             ¦
¦  8 - SCREEN PAGING                                                             ¦
¦  9 - EXIT TO MAIN MENU                                                         ¦
¦ 10 - RUN ALL ABOVE TESTS                                                       ¦
¦ 11 - VIDEO TEST                                                                ¦
¦ 12 - SYNC TEST                                                                 ¦
¦                                                                               ¦
¦                                                                               ¦
+-------------------------------------------------------------------------------+
```

0 - DISPLAY SELF TEST: Tests the video memory, video registers, scan
frequency, and monitor interface.

1 - DISPLAY ATTRIBUTES: Tests the display attribute logic for intensity,
reverse video, blinking, non-display, and underline modes.

2 - CHARACTER SET: Tests character ROM by displaying all of the available
characters.

3 - 80X25 DISPLAY: Fills the screen with a pattern of characters, in the
80-by-25 display mode.

4 - 40X25 DISPLAY: Fills the screen with a pattern of characters and an
intensified white border in the 40-by-25 display mode.

5 - 320X200 GRAPHICS: Tests the 320-by-200 graphics mode and displays
graphics tests 1, 2, and 3.

6 - 640X200 AND 640X480 GRAPHICS: Tests the 640-by-200 and 640-by-480
graphics modes.

8 - SCREEN PAGING: Tests the video addressing circuitry.

9 - EXIT TO MAIN MENU: Returns to the System Checkout menu.

10 - RUN ALL ABOVE TESTS: Performs tests 0 through 8.

11 - VIDEO TEST: Provides a test signal to allow voltage measurements at
the video and intensity outputs.

12 - SYNC TEST: Provides a test signal to allow voltage measurements at
the horizontal and vertical synchronization outputs.

5.3 Utilities

Subtopics
5.3.1 Select an Option Menu
5.3.2 Formatting a Fixed Disk Drive
5.3.3 Format Selection Menu
5.3.4 Error Log

5.3.1 Select an Option Menu

This menu appears first if the system options are correctly set.

```
+------------------------------------------------------------------------------+
¦                                                                              ¦
¦                                                                              ¦
¦                                                                              ¦
¦  SELECT AN OPTION                                                            ¦
¦                                                                              ¦
¦   0 - SYSTEM CHECKOUT                                                        ¦
¦   1 - FORMAT DISKETTE                                                        ¦
¦   2 - COPY DISKETTE                                                          ¦
¦   3 - PREPARE SYSTEM FOR MOVING                                             ¦
¦   4 - SETUP                                                                  ¦
¦   5 - SET TIME AND DATE                                                      ¦
¦   9 - END DIAGNOSTICS                                                        ¦
¦                                                                              ¦
¦                                                                              ¦
¦                                                                              ¦
+------------------------------------------------------------------------------+
```

0 - SYSTEM CHECKOUT: Starts the system checkout procedure.

1 - FORMAT DISKETTE: Formats a "scratch" diskette for diagnostic use
only.

Note: In a 1.44MB diskette drive, the format diskette option formats a
        2.0MB diskette to contain 80 tracks with 18 sectors per track.

2 - COPY DISKETTE: Copies the Advanced Diagnostics diskette to another
diskette.

3 - PREPARE SYSTEM FOR MOVING: Prepares the fixed disk drive when moving
the system.

4 - SETUP: Allows you to check or set the system configuration.

5 - SET TIME AND DATE: Allows you to check or set the time and date.

9 - END DIAGNOSTICS: Loads a program from the diskette in drive A.

5.3.2 Formatting a Fixed Disk Drive

To allow for defective tracks, fixed disk drives normally contain tracks
in excess of their stated capacity. When the defect limit has been
reached and service is recommended, the user is notified by a diagnostic
message.

The Advanced Diagnostics Format program is different from the operating
system format program. Before the customer can transfer information from
the backup diskettes to the fixed disk drive, the fixed disk drive must be
formatted using the operating system format program. Have the customer
refer to the operating system manual for a description of the fixed disk
preparation commands.

Warning: All data on the selected fixed disk drive is destroyed during a
format operation or surface analysis.

5.3.3 Format Selection Menu

```
+-------------------------------------------------------------------------------+
¦                                                                               ¦
¦                                                                               ¦
¦                                                                               ¦
¦                                                                               ¦
¦   FORMAT SELECTION MENU                                                       ¦
¦   ---------------------                                                       ¦
¦   1 - CONDITIONAL FORMAT                                                      ¦
¦   2 - UNCONDITIONAL FORMAT                                                    ¦
¦   3 - SURFACE ANALYSIS                                                        ¦
¦   9 - RETURN TO FIXED DISK MENU                                              ¦
¦                                                                               ¦
¦                                                                               ¦
¦                                                                               ¦
+-------------------------------------------------------------------------------+
```

1 - CONDITIONAL FORMAT: Scans for any defective sectors, then formats,
except for any known defective sectors.

2 - UNCONDITIONAL FORMAT: Formats all sectors, except for any defective
sectors you specify.

Warning: Before selecting the unconditional format, always perform
read-verify with the printer powered-on to list known defective tracks.
You will be prompted to re-enter this information during the unconditional
format.

3 - SURFACE ANALYSIS: Scans by writing, reading, and comparing a unique
data pattern to detect any defective tracks.

9 - RETURN TO FIXED DISK MENU: Returns to the Fixed Disk Diagnostic menu.

Formatting Procedure: Before replacing a failing fixed disk drive, try to
format it as follows:

Warning: Formatting results in a complete loss of data on the fixed disk
drive. Have the customer backup all information on the fixed disk drive,
if possible, before proceeding further.

1. Power-off the system. Check that the fixed disk drive cable is
    securely connected.

2. Insert the Advanced Diagnostics diskette into drive A.

3. Power-on the system.

4. Press **0 (SYSTEM CHECKOUT)**; then press **Enter**.

5. Depending on the options installed in the system, questions about
    attached devices are displayed on the screen. Answer as required;
    then press **Enter**.

6. Press **Y (IS THE LIST CORRECT (Y/N)?)**; then press **Enter**. If the list
    is incorrect, follow the instructions on the screen to correct the
    list before answering Yes.

7. Press **0 (RUN TESTS ONE TIME)**; then press **Enter**.

8. Type **17 (FIXED DISK DRIVE)**; then press **Enter**.

9. Press **7 (FORMAT MENU)**; then press **Enter**.

10. Type **1, C**; then press **Enter**.

11. Press **Y** or **N (ALL DEFECTS WILL BE SHOWN ON THE DISPLAY, THEY CAN ALSO
    BE PRINTED ON LPT1. IS A HARD COPY NEEDED?)**; then press **Enter**.

12. Press **Y (DO YOU WANT TO CONTINUE (Y/N)?)**; then press **Enter**.

13. If you were instructed to perform an **UNCONDITIONAL FORMAT**, follow the
    instructions on the screen.

5.3.4 Error Log

Use the following steps to create an error log, run the diagnostic tests, and automatically record any error messages in an error log. This procedure is normally used to diagnose an intermittent problem.

Note: The errors must be logged to a diskette drive that is not being tested, or to a printer. If recording errors on a diskette, use a copy of the Advanced Diagnostics diskette that is not write-protected.

Creating the Error Log

1. Load the Advanced Diagnostics from drive A.

2. Press **0 (SYSTEM CHECKOUT)**; then press **Enter**.

3. Depending on the options installed in the system, questions about attached devices may be displayed on the screen. Answer as required; then press **Enter**.

4. Press **Y** or **N (IS THE LIST CORRECT (Y/N)?)**; then press **Enter**.

5. Press **2 (LOG UTILITIES)**; then press **Enter**.

6. Press **0 (START ERROR LOG)**; then press **Enter**.

7. Press **0 (LOG TO DISKETTE, OR PRINTER (0/1)?)**; then press **Enter**.

8. If logging to diskette, press **A** or **B (ENTER THE DRIVE ID FOR ERROR LOG?)**; then press **Enter**.

9. Press **9 (END LOG UTILITIES)**; then press **Enter**.

Starting the Test

1. Press **1 (RUN TESTS MULTIPLE TIMES)**; then press **Enter**.

2. Select the device you suspect has a failure; then press **Enter**.

3. Select the number of times the test is to be run; then press **Enter**.

4. Press **N (WAIT EACH TIME AN ERROR OCCURS (Y/N)?)**; then press **Enter**.

5. Follow any instructions on the screen and select all available tests.

6. To end **(RUN TEST CONTINUOUSLY)**, press and hold the **Ctrl** key; then press the **Break** key. The system will complete testing and return to the Installed Device menu.

Displaying the Error Log

1. Depending on the options installed in the system, questions about attached devices are displayed on the screen. Answer as required, then press **Enter**.

2. Press **Y** or **N (IS THE LIST CORRECT (Y/N)?)**; then press **Enter**.

3. Press **2 (LOG UTILITIES)**; then press **Enter**.

4. Press **2 (DISPLAY LOG)**; then press **Enter**.

5. Press **A** or **B (ENTER THE DRIVE ID FOR ERROR LOG?)**; then press **Enter**.

6. If no errors occurred, the Log Utilities menu is displayed. If errors are displayed, go to the *Hardware Maintenance Service* pamphlet for the system you are servicing.

5.4 Setup Program

The Setup program allows the user to view or change the current system
configuration. The system configuration can be set through manual
selections or done automatically. In the automatic configuration, the
system changes the configuration to what it determines is installed.

Subtopics
5.4.1 Set Configuration Menu

5.4.1 Set Configuration Menu

This menu allows you to view or change the current system configuration:

```
+-------------------------------------------------------------------------------+
¦                                                                               ¦
¦                                                                               ¦
¦                                                                               ¦
¦                                                                               ¦
¦  SET CONFIGURATION MENU                                                       ¦
¦                                                                               ¦
¦   1 - VIEW CONFIGURATION                                                      ¦
¦   2 - CHANGE CONFIGURATION                                                    ¦
¦   3 - BACKUP CONFIGURATION                                                    ¦
¦   4 - RESTORE CONFIGURATION                                                   ¦
¦   5 - RUN AUTOMATIC CONFIGURATION                                             ¦
¦                                                                               ¦
¦                                                                               ¦
+-------------------------------------------------------------------------------+
```

1 - VIEW CONFIGURATION: Shows the current system configuration.

2 - CHANGE CONFIGURATION: Allows the current configuration to be changed.

Note: Only those items enclosed in brackets can be changed by using the
F5 and F6 keys.

3 - BACKUP CONFIGURATION: Saves the system configuration to a diskette or
fixed disk.

4 - RESTORE CONFIGURATION: Sets the system configuration from data
created with Backup configuration.

5 - RUN AUTOMATIC CONFIGURATION: Sets the configuration to default values
and to what the system determines is installed.

Note: If the configuration is changed during service, refer the customer
to the Guide to Operations to restore the system configuration to
the original configuration.

6.0 Hardware Maintenance Service Pamphlets

You will be able to determine which FRU is causing a failure by following
the service pamphlet and using the advanced diagnostic tests on the
Advanced Diagnostics Diskette.

You should always begin with the "General Checkout" procedure. Depending
on the failure indication, this procedure directs you to the
"Symptom-To-FRU Index" or to the advanced diagnostic tests. The
Symptom-To-FRU Index lists symptoms and error numbers along with the most
probable FRUs causing the failure. Use the Symptom-to-FRU Index to have
the proper replacement FRUs available when you service the failing system.

The service pamphlets and the Advanced Diagnostics Diskettes are located
in the *Hardware Maintenance Service* manual.

7.0 Display Self-Test

1. Power-off the system unit and display.

2. Disconnect the display signal cable.

3. Power-on the display.

4. Turn the contrast to its maximum position.

5. Turn the brightness control to the center detent position.

The screen should be white with a black margin, as described below (some shading may occur near the edges). If the screen differs, replace the display. If the display passes the test, replace the system board or display adapter that the display is attached to.

> **8503, 8512, 8513, 8514:** 2-20 mm (0.08-0.79 in.) wide on one or both sides.

> **8506:** 2-35 mm (0.08-1.38 in.) wide on the top, or bottom, or both.

> **8507, 8508:** 2-20 mm (0.08-0.79 in.) wide on the top, or bottom, or both.

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