

## **Introduction to Diagnostics**

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# SECTION 2. INTRODUCTION TO DIAGNOSTICS

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# Notes:



The main aids in isolation of a failing FRU are:

- Power-On Self Test (POST)
- Advanced Diagnostic Tests
- Maintenance Analysis Procedures (MAPs).

This section describes these service aids and gives you an understanding of how the diagnostic aids work together in solving problems that you will encounter. You will not have to use this manual each time you service a system. Once you become familiar with the diagnostic techniques, the manual will serve as a useful reference.

When instructed by the maintenance procedures, to "Power on the system," apply power to the system unit and all externally attached devices (such as, displays, printers, plotters). If an expansion unit is attached, it must be powered on before the system unit.

## Power-On Self Test

Each time you power on the system, the power-on self test (POST) is performed. The POST takes from 13 to 90 seconds to finish, depending on the options installed.

The POST checks the following:

- System Board
- Memory
- Drive Adapter
- Primary Display Adapter
- Keyboard
- Diskette Drives

- Fixed Disk Drives.

To start the POST:

1. Power on the system.
2. Turn the Brightness and Contrast knobs fully clockwise (IBM displays).

The following will happen:

- Memory is tested. The memory size appears in the top left corner of the screen and increases in 16K increments until the total system memory is tested. On an IBM Personal Computer a blinking cursor is displayed.
- One short beep is heard when the POST is successfully completed.
- The IBM Personal Computer BASIC screen appears (if an operating system is not automatically loaded from diskette or fixed disk drive).

If the POST cannot be completed and the following error message appears on the display:

**(RESUME = "F1" KEY)**

**Note:** The F1 function is supported on the IBM Personal Computer XT and the IBM Portable Personal Computer.

press the F1 key; the system unit bypasses the error and attempts to complete the POST. The POST may or may not finish, depending on the error.

# Advanced Diagnostics Diskette

The advanced diagnostic tests are on the diskette that is located in the *Hardware Maintenance Service* manual. The Advanced Diagnostics diskette and *Hardware Maintenance Service* manual should be used to isolate failures on the IBM Personal Computer family.

## Notes:

1. You should make a copy of this diskette and put the original in a safe place.
2. Some diagnostic tests require a write-protected diskette to be used. If you are using a copy of the original Advanced Diagnostics diskette be sure it is write protected when running the diagnostic tests.

## Starting the Advanced Diagnostic Tests

Do the following to load the advanced diagnostic tests.

1. Insert the Advanced Diagnostics diskette into drive A.
2. Power on the system.

The advanced diagnostic tests load after completion of the POST, and the Select an Option menu appears on the screen.

You are now ready to select and run the diagnostic tests.

## Diagnostic Program

The diagnostic programs consist of a diagnostic control program (DCP) and a module of code for each device that is supported by the system. If new devices (options) are announced, modules of code are added to new diagnostic diskettes and distributed as supplements to this library. Some products come with their own unique diagnostics diskette and Hardware Maintenance library.

## Presence Test

During program load, the DCP links to each of the modules on the diskette, in sequence, and performs a presence test for the device that module supports. For a successful presence test to occur, the following conditions must be met:

1. The module of diagnostic code for that device must reside on the diskette.

**Note:** Some devices have their own unique diagnostics diskette.

2. The device must be installed or attached.
3. The device must return a 'ready' acknowledgment value to the DCP.

If these conditions are met, the DCP loads that module into memory, adds the device name to the Installed Devices menu, and continues with the next module. This continues until the DCP has performed a presence test for each module resident on the diskette. When all the presence tests have been performed, the DCP posts the Installed Devices menu on the display screen.



## **Installed Devices Menu**

The Installed Devices menu lists the devices that met all the conditions described in 'Presence Test.' The service person must verify this list.

An incorrect 'Installed Device List' can be caused by:

1. The module of code for that device is not on the diskette.
2. The device is unknown to the DCP and ignored.
3. The device is not installed or attached.
4. The device is broken.
5. Jumpers or switch settings are incorrect.

## Special Keys

Keys with special functions for the advanced diagnostic tests are:

Key	Use
<b>F1</b>	Forces the system unit to bypass an error and continue with POST.

**Note:** The F1 function is supported on the IBM Personal Computer XT and the IBM Portable Personal Computer.

<b>F7</b>	Moves the screen message to the left (color displays only).
<b>F8</b>	Moves the screen message to the right (color displays only).
<b>Ctrl + P</b>	Directs screen output to the printer.
<b>Ctrl + N</b>	Cancels output to the printer.
<b>Ctrl + C</b>	Stops diagnostic tests and returns to the Installed Devices menu.
<b>Ctrl + S</b>	Stops diagnostic tests. Press any key to continue.
<b>Shift + PrtSc</b>	Prints what is on the screen (useful when the display is unreadable).

## Diagnostic Menus

The following pages show the main diagnostic menus and describe what each menu selection does. Depending on the options installed, all of these menus may not appear on the screen.

Depending on the configuration of your system, questions about attached devices may appear on the screen. Answer as required, then press Enter.

## Select an Option Menu

This menu appears first when the POST is completed.

The IBM Personal Computer  
ADVANCED DIAGNOSTICS  
Version X.XX (C) Copyright IBM Corp 1981, 1985  
ROS P/N: XXXXXXX  
ROS DATE: XX/XX/XX

### SELECT AN OPTION

- 0 - SYSTEM CHECKOUT
- 1 - FORMAT DISKETTE
- 2 - COPY DISKETTE
- 3 - PREPARE SYSTEM FOR MOVING
- 9 - END DIAGNOSTICS

ENTER THE ACTION DESIRED

?

**0 - SYSTEM CHECKOUT:** Starts the system checkout procedure.

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

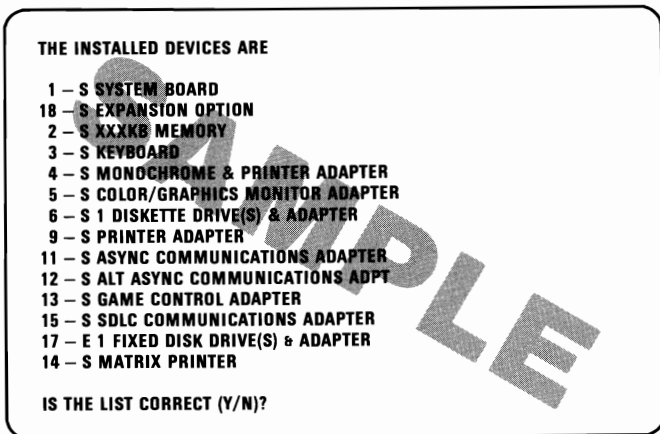
**2 - COPY DISKETTE:** Copies the Advanced Diagnostics program to another diskette.

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

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

## Installed Devices Menu

This menu displays the options and devices installed in the system. The screen below is an example.



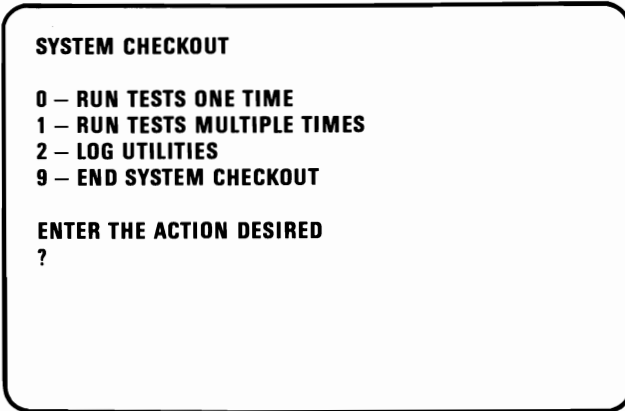
**Y** - Continues with system diagnostic tests.

**N** - Allows you to add or delete items from the Installed Devices menu.

**Note:** If you enter **N**, the screen displays the installed devices list error, **199**. Disregard this error and continue to add or delete the options. After correcting the list, answer **Y** to continue. If you are unable to correct the list, you still must answer **Y** to continue.

## System Checkout Menu

This menu allows you to choose the number of times a test is run, use the error log, or end system checkout.

A screenshot of a terminal window showing the 'SYSTEM CHECKOUT' menu. The menu is enclosed in a rounded rectangular border. The text inside the window is as follows:

```
SYSTEM CHECKOUT

0 - RUN TESTS ONE TIME
1 - RUN TESTS MULTIPLE TIMES
2 - LOG UTILITIES
9 - END SYSTEM CHECKOUT

ENTER THE ACTION DESIRED
?
```

**0 - RUN TESTS ONE TIME:** Runs the diagnostic tests once.

**1 - RUN TESTS MULTIPLE TIMES:** Runs the diagnostic tests once or several times without operator intervention.

**2 - LOG UTILITIES:** Allows you to use the error log and time-of-day functions.

**9 - END SYSTEM CHECKOUT:** Returns to the Select an Option menu.

## Installed Devices Test

This menu allows you to choose specific devices to test, or to test all of the devices listed.

- 1 - S SYSTEM BOARD
- 18 - S EXPANSION OPTION
- 2 - S XXXKB MEMORY
- 3 - S KEYBOARD
- 4 - S MONOCHROME & PRINTER ADAPTER
- 5 - S COLOR/GRAPHICS MONITOR ADAPTER
- 6 - S 1 DISKETTE DRIVE(S) & ADAPTER
- 9 - S PRINTER ADAPTER
- 11 - S ASYNC COMMUNICATIONS ADAPTER
- 12 - S ALT ASYNC COMMUNICATIONS ADPT
- 13 - S GAME CONTROL ADAPTER
- 15 - S SDLC COMMUNICATIONS ADAPTER
- 17 - E 1 FIXED DISK DRIVE(S) & ADAPTER
- 14 - S MATRIX PRINTER

ENTER THE NUMBER(S) OF OPTIONS TO TEST  
OR PRESS ENTER TO SELECT ALL OPTIONS  
?

Select the devices to be tested by entering their corresponding numbers, separated by commas or spaces. To test all options, press Enter.

## Log Utilities Menu

This menu allows you access to the error log.

**LOG UTILITIES**

**0—START ERROR LOG**  
**1—STOP ERROR LOG**  
**2—DISPLAY LOG**  
**3—SET TIME OF DAY**  
**4—DISPLAY TIME OF DAY**  
**9—END LOG UTILITIES**

**ENTER THE ACTION DESIRED**

**0 - START ERROR LOG:** Starts a record of errors detected by diagnostic tests. You can choose to record the errors on a diskette or have them printed. If recording errors on a diskette, use a copy of the Advanced Diagnostics diskette that is not write protected.

**Note:** You cannot log errors to a diskette drive that is being tested. If you plan to test a diskette drive, you must log the errors to a diskette drive that is not being tested, or to a printer.

**1 - STOP ERROR LOG:** Stops recording errors detected by diagnostic tests.

**2 - DISPLAY LOG:** Displays the errors that were logged to the diskette.

**3 - SET TIME OF DAY:** Allows you to set the current time of day, using a 24-hour clock.

**4 - DISPLAY TIME OF DAY:** Displays the time elapsed since the diagnostic program was loaded.

**9 - END LOG UTILITIES:** Returns you to the System Checkout menu.



# IBM Monochrome Display and Printer Adapter

**IBM MONOCHROME DISPLAY AND  
PRINTER ADAPTER TEST**  
0-DISPLAY ADAPTER  
1-DISPLAY ATTRIBUTES  
2-CHARACTER SET  
3-80X25 DISPLAY  
4-PRINTER ADAPTER TEST  
9-EXIT TO MAIN MENU  
10-RUN ALL ABOVE TESTS  
11-VIDEO TEST  
12-SYNC TEST  
ENTER NUMBER OF DESIRED ACTION

**CHOOSE OPTIONS FOR UNATTENDED MODE**  
**IBM MONOCHROME DISPLAY AND  
PRINTER ADAPTER TEST**  
0-DISPLAY ADAPTER TEST  
1-DISPLAY ATTRIBUTES  
2-CHARACTER SET  
3-80X25 DISPLAY  
4-PRINTER ADAPTER TEST  
9-EXIT TO MAIN MENU  
10-RUN ALL ABOVE TESTS  
ENTER NUMBERS SEPARATED BY COMMAS

**0 - DISPLAY ADAPTER TEST:** Tests the memory and correct addressing on the adapter.

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

**2 - CHARACTER SET:** Tests character read only memory (ROM) by displaying all of the available characters.

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

**4 - PRINTER ADAPTER TEST:** Tests the Printer Adapter portion of the Monochrome Display and Printer Adapter.

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

**10 - RUN ALL ABOVE TESTS:** Performs tests 0 through 4.

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

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

**Note:** Because of the change in synchronization frequency, disconnect the display signal cable before doing the Sync Test.

## Color/Graphics Monitor Adapter

This menu allows you to test the Color/Graphics Monitor Adapter.

### COLOR/GRAPHICS MONITOR ADAPTER TEST

0-DISPLAY ADAPTER TEST  
1-DISPLAY ATTRIBUTES  
2-CHARACTER SET  
3-80X25 DISPLAY  
4-40X25 DISPLAY  
5-320X200 GRAPHICS  
6-640X200 GRAPHICS  
7-LIGHT PEN TEST  
8-SCREEN PAGING  
9-EXIT TO MAIN MENU  
10-RUN ALL ABOVE TESTS  
11-VIDEO TEST  
12-SYNC TEST  
ENTER NUMBER OF DESIRED ACTION

### CHOOSE OPTIONS FOR UNATTENDED MODE COLOR/GRAPHICS MONITOR ADAPTER TEST

0-DISPLAY ADAPTER TEST  
1-DISPLAY ATTRIBUTES  
2-CHARACTER SET  
3-80X25 DISPLAY  
4-40X25 DISPLAY  
5-320X200 GRAPHICS  
6-640X200 GRAPHICS  
8-SCREEN PAGING  
9-EXIT TO MAIN MENU  
10-RUN ALL ABOVE TESTS  
ENTER NUMBERS SEPARATED BY COMMAS

**0 - DISPLAY ADAPTER TEST:** Tests the memory and correct addressing on the Color/Graphics Monitor Adapter.

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

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

**5 - 320 X 200 GRAPHICS:** Tests the 320-by-200 graphics mode and displays color set 0 and color set 1.

**6 - 640 X 200 GRAPHICS:** Tests the 640-by-200 graphics mode.

**7 - LIGHT PEN TEST:** Tests the light pen and the related circuitry on the Color/Graphics Monitor Adapter.

**8 - SCREEN PAGING:** Tests the addressing circuitry from the video controller chip to the Color/Graphics Monitor Adapter memory.

**9 - EXIT TO MAIN MENU:** Returns to the Select an Option 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, intensity, and composite outputs.

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

**Note:** Because of the change in synchronization frequency, disconnect the display signal cable before doing the Sync Test.

## Diskette Drive and Adapter

This menu allows you to test the diskette drives and the Diskette Drive Adapter.

### TESTING – 1 DISKETTE DRIVE(S) & ADAPTER

#### DISKETTE DIAGNOSTIC MENU

OPTION	DRIVE
1-SEQUENTIAL ACCESS	ONE DRIVE
2-RANDOM SEEK	ONE DRIVE
3-VERIFY DISKETTE	ONE DRIVE
4-SPEED TEST	ONE DRIVE
9-RETURN TO CONTROL PROGRAM	

FOR OPTION 9  
ENTER "9" AND "ENTER"  
FOR OTHER OPTIONS (1 THRU 4)  
ENTER OPTION, DRIVE AND "ENTER"

**1 - SEQUENTIAL ACCESS:** Tests the basic diskette operations, including a sequential write, read, and comparison of data on all sectors of the diskette.

**2 - RANDOM SEEK:** Tests the basic diskette operations, including a series of 50 random seeks, each seek being followed by a write, read, and comparison of data.

**3 - VERIFY DISKETTE:** Verifies data accessing and each sector.

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

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

## Fixed Disk Drive and Adapter

This menu allows you to test the fixed disk drives and the Fixed Disk Adapter.

**ENTER THE ACTION DESIRED  
TESTING – 2 FIXED DISK DRIVE(S) & ADAPTER**

**0–RUN FIXED DISK TEST  
1–RUN MEASUREMENTS TEST  
2–FORMAT FIXED DISK  
9–EXIT FIXED DISK TESTS**

**ENTER THE ACTION DESIRED?**

**0 - RUN FIXED DISK TEST:** Tests the Fixed Disk Drive Adapter and the fixed disk drive (C or D) read and write operation.

**1 - RUN MEASUREMENTS TEST:** Provides a test signal to measure voltage levels at selected test points.

**2 - FORMAT FIXED DISK:** Formats the fixed disk drive. All data on the fixed disk drive is destroyed when this option is selected.

**9 - EXIT FIXED DISK TESTS:** Returns to System Checkout menu.

# Formatting a Fixed Disk Drive

## Notes:

1. A fixed disk drive must be formatted before use.
2. The diagnostic tests will not run on an unformatted fixed disk drive.
3. Fixed disk drives normally contain tracks in excess of their stated capacity to allow for defective tracks. The user is notified by a diagnostic message when the defect limit has been reached and service is recommended.
4. The Advanced Diagnostics Format program is different from the operating system format program. Before transferring information from backup diskettes to the fixed disk drive, format the fixed disk drive using the operating system diskette; refer to the operating system manual for a description of the format commands.

Before you replace 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; refer to the operating system manual and back up all information, if possible.

1. Power off the system.
2. Be sure all fixed disk drive and fixed disk adapter cables are connected and tight.
3. Insert the Advanced Diagnostics diskette into drive A.
4. Power on the system.
5. Press **0 (SYSTEM CHECKOUT)** then **Enter**.
6. Depending on the options installed in the system, questions about attached devices will appear on the screen. Answer as required, then **Enter**.

7. Press **Y (IS THE LIST CORRECT (Y/N)?)** then **Enter**. If the list is incorrect, follow the instructions on the screen to correct the list before answering Yes. If you cannot correct the list, you still must answer Yes before you can continue.
8. Press **0 (RUN TESTS ONE TIME)** then **Enter**.
9. Select **17 (FIXED DISK DRIVE(S) & ADAPTER)** then press **Enter**.
10. Press **2 (FORMAT FIXED DISK)** then **Enter**.
11. Select **(DRIVE ID)**, then **Enter**.
12. Press **Y (ARE YOU SURE YOU WANT TO CONTINUE Y/N?)** then **Enter**.



# System Checkout

Running diagnostic tests is always the correct path for diagnosing any problem you encounter. We also recommend that you run the diagnostic tests every time a new option is installed or after any maintenance work is done on the system.

1. Load the Advanced Diagnostics diskette into drive A.
2. Power on the system.
3. When the Select an Option menu appears, select **0 (SYSTEM CHECKOUT)**.
4. Depending on the options installed in the system, questions about attached devices will appear on the screen. Answer as required, then **Enter**.
5. When the Installed Device list appears, check the list carefully for all installed options that are in the system. If any installed options are missing, answer **No** to the question and try to add the missing option to the list. If the list is **OK**, answer **Yes** to the question and continue.

**Note:** If you enter **N**, the screen displays the installed devices list error, **199**. Disregard this error and continue to add or delete the options. After correcting the list, answer **Yes** to continue. If you are unable to correct the list, you still must answer **Yes** to continue the diagnostic tests.

6. Next the System Checkout menu appears. From this menu you have the choice of running tests on each option installed in the system. You can either run the tests one time or multiple times.

7. When you select either 1 or 2, the Installed Device menu appears. By selecting from this list you may run tests on any of the installed options. Press Enter to test all of the installed options.

When running tests, if the last two digits in the return code are 00, the test ran successfully.



# Error Log

The following steps will allow you to create an error log, run the diagnostic tests, and automatically record any error messages in an error log. This procedure is normally used when diagnosing an intermittent problem.

## Creating the Error Log

1. Load the Advanced Diagnostics diskette from drive A.
2. Press **0 (SYSTEM CHECKOUT)** then **Enter**.
3. Depending on the options installed in the system, questions about attached devices will appear on the screen. Answer as required, then **Enter**.
4. Press **Y** or **N (IS THE LIST CORRECT (Y/N)?)** then **Enter**.
5. Press **2 (LOG UTILITIES)** then **Enter**.
6. Press **0 (START ERROR LOG)** then **Enter**.
7. Select **(LOG TO DISK, CASSETTE, OR PRINTER (D C P)?)** then press **Enter**.

The following appears only if you log to diskette.

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

**Note:** You cannot log errors to a diskette drive that is being tested. If you plan to test a diskette drive, you must log the errors 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.

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

## Starting the Test

1. Press **1 (RUN TESTS MULTIPLE TIMES)** then **Enter**.
2. Select the device you suspect has a failure, then press **Enter**.
3. Press **N (WAIT EACH TIME AN ERROR OCCURS (Y/N)?)** then **Enter**.
4. Follow the instructions on the screen and select all available tests.

## End the Test and Display the Error Log

1. Press and hold the **Ctrl** key; then press the **Break** key.
2. Depending on the options installed in the system, questions about attached devices will appear on the screen. Answer as required, then **Enter**.
3. Press **Y** or **N (IS THE LIST CORRECT (Y/N)?)** then **Enter**.
4. Press **2 (LOG UTILITIES)** then **Enter**.
5. Press **2 (DISPLAY LOG)** then **Enter**.
6. Press **A** or **B (ENTER THE DRIVE ID FOR ERROR LOG?)** then **Enter**.
7. If no errors occurred, the Log Utilities menu appears. If errors are displayed, go to the *Hardware Maintenance Service* manual and refer to the MAP indicated by the error code. If there is no corresponding MAP for the error code, go to "MAP 0000: Start."

# Maintenance Analysis Procedures (MAPs)

The MAPs, located in the *Hardware Maintenance Service* manual, are a series of steps that require you to answer questions and perform some actions. You will be able to determine which field replaceable unit (FRU) is causing the failure by following the MAPs and using the Advanced Diagnostics diskette. You should always begin with the Start MAP. Depending on the failure indication, the Start MAP directs you to one of the other MAPs.

**Notes:**

