

Installation Guide for Intel[®] Above[™] Board MC



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Adding Memory to the Above Board MC



If Your Board Doesn't Work

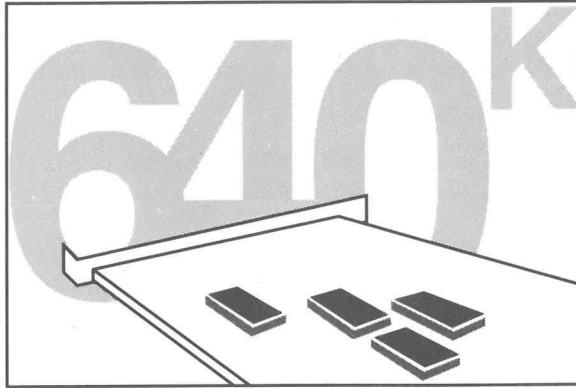


How Extended and Expanded Memory Work



Technical Information

Getting Started

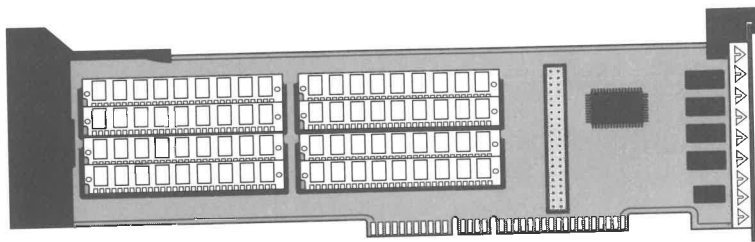


Chapter 1

GETTING STARTED

The Intel Above™ Board MC (shown in Figure 1-1) is a memory expansion board, designed for use in IBM Micro Channel computers and 100% compatible Micro Channel computers. It allows you to add up to 32M bytes of RAM per board to your computer. You can use this added memory to run

- programs that use extended memory, such as Microsoft Windows 3.0, Lotus 1-2-3 Rel. 3.1, and Autodesk AutoCAD 386.
- programs that use expanded memory, such as Borland QuattroPro, WordPerfect, Quarterdeck DESQview, and Lotus 1-2-3 Rel. 2.2.
- non-DOS operating systems such as IBM OS/2 or XENIX.



PC-0765

Figure 1-1 *Above Board MC*

WHICH COMPUTERS CAN USE THE ABOVE BOARD MC?

The Above Board MC works only in computers that use IBM's Micro Channel architecture. These computers include:

- the IBM PS/2, Models 50, 50Z, 55SX, 60, 65SX, 70, P70, and 80.
- all non-IBM computers that are 100% compatible with the IBM Micro Channel specification.

I/O OPTION FOR THE ABOVE BOARD MC

Intel offers an optional I/O board (available in mid-1991). The Intel I/O Option attaches to a connector on the Above Board MC and provides one serial port and one parallel port. You can use these ports to connect modems, printers, or plotters to your computer.

The I/O Module is sold separately from the Above Board. Instructions for installing the I/O Module are provided with the module.

WHAT'S IN THE ABOVE BOARD MC BOX?

The Above Board MC box includes the following:

- the Intel Above Board MC memory expansion board
- the Intel Option diskette
- this *Above Board MC Installation Guide*
- the *Quick Guide to Installing the Above Board MC*
- a bulletin entitled *Read This First*.

▼ **NOTE** The remainder of this manual refers to the Above Board MC simply as the Above Board.

ABOUT THIS INSTALLATION GUIDE

This installation guide shows you how to install the Above Board in your Micro Channel computer and set up your computer to use the memory on the board.

If you're an experienced Micro Channel board installer, use the *Quick Guide to Installing the Above Board MC* to install your board. It's been streamlined for experienced users.

If you're new to installing Micro Channel boards, use the installation procedure in Chapter 2 of this guide. This chapter provides detailed instructions for installing and setting up your Above Board and is aimed at less experienced computer users.

Here's what you'll find in the remaining chapters and appendices of this book.

Chapter 3, "Getting the Most From Your Above Board MC", describes the more important features of the Above Board and how to get optimum use of them.

Appendix A, "Adding Memory to Your Above Board MC", shows how to add SIMMs to your board.

Appendix B, "If Your Above Board MC Doesn't Work", gives detailed troubleshooting information and instructions for contacting Intel Customer Support.

Appendix C, "How Extended and Expanded Memory Work", describes the difference between extended memory and expanded memory and gives some notes on using the Above Board to map conventional memory.

Appendix D, "Technical Information", describes the SOFTSET and EMM parameters, which are provided for experienced users who need to adapt the Above Board for special situations.

A detailed index is provided at the end of this guide.

LAST MINUTE UPDATES

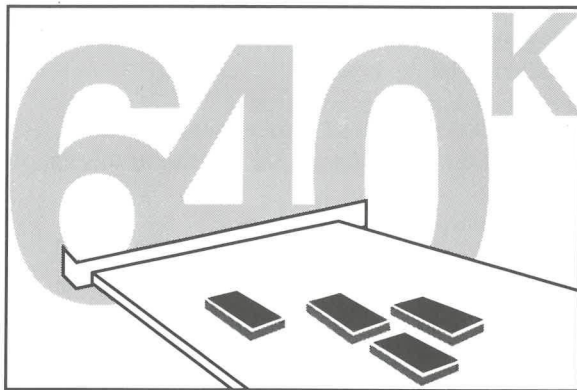
The *Read This First* bulletin and a README file on the Intel Option diskette describe compatibility issues that could affect the installation of your Above Board and other information found after this manual went to print. We suggest you review this information before you install your board.

To read the README file, insert the Intel Option diskette in your computer and type the following at the DOS prompt:

```
A: README <ENTER>
```

Use the arrow, PAGEUP, and PAGEDOWN keys of your keyboard to scroll through the text. To exit the file, press the ESC key.

Installation Procedure



Chapter 2

INSTALLATION PROCEDURE

This chapter shows how to install an Above Board in a Micro Channel computer. The examples given are for IBM PS/2 Micro Channel computers. If you have trouble, refer to your computer's reference manual for information on installing boards.

If you're an experienced Micro Channel board installer, use the *Quick Guide to Installing the Above Board MC* instead of this chapter.

Installing the Above Board takes five steps:

- Make a backup copy of your Intel Option diskette.
- Insert the Above Board in your computer.
- Set up your computer for the Above Board.
- (Optional) Run SOFTSET to install expanded memory.
- (Optional) Check your memory.

WHERE TO FIND TROUBLESHOOTING INFORMATION

If you're unable to complete any of the steps of this installation procedure, go to Appendix B "If Your Above Board MC Doesn't Work" and follow the troubleshooting suggestions listed there.

MAKE A BACKUP COPY OF YOUR INTEL OPTION DISKETTE

Copy the Intel Option diskette onto a blank diskette (formatted or unformatted).

- Insert the Option diskette in drive A.
- From the DOS prompt, type

DISKCOPY A: B: <ENTER>

and follow the on-screen prompts.

INSERT THE ABOVE BOARD IN YOUR COMPUTER

- 1 Turn off the power switch for your computer.
- 2 Disconnect your computer's power cable from the wall outlet.
- 3 Remove the cover or side panel from your computer.
- 4 Remove the Above Board from its anti-static wrapper, and lay the board on the wrapper and on a level surface.

The Above Board components can be damaged by discharge of static electricity. Placing your board on the anti-static wrapper while you work with it reduces the chance of damaging the board through static discharge. If you have a static-discharge wrist cord, wear it when you handle the board.

- 5 If you wish to add additional SIMMs to the Above Board, add them now.

Refer to Appendix A for instructions on adding SIMMs.

- 6 Write down the speed of the SIMMs in your Above Board and the total amount of memory on the board.

Speed of SIMMs: _____

Total Memory: _____

The suffix of the memory chip's identification number indicates its speed. Refer to Table A-2 in Appendix A for information on interpreting these numbers. If you can't determine the speed of your SIMMs, assume it is 100 ns.

The total amount of memory on your Above Board board is the number of SIMMS times the amount of memory per SIMM. For example, if your board has four 1M-Byte SIMMs, your total memory is 4 x 1M Byte, or 4M bytes.

7 If you wish to install an Intel I/O Option on your Above Board, install it now.

A procedure for installing the I/O Option is provided with the module.

8 Determine the expansion slot where you're going to install the Above Board.

The PS/2 Models 70 and 80 computers provide both 16- and 32-bit expansion slots and the Model P70 provides an 8-bit and a 32-bit slot. In these models, install the Above Board in a 32-bit slot. (Figure 2-1 shows the location of the expansion slots in a IBM PS/2 Model 70 computer.)

The PS/2 Models 50, 50Z, 55SX, 60, and 65SX have only 16-bit expansion slots. Install the Above Board in any of these slots.

▼ HINT *When you install the Above Board in a 32-bit slot, the entire board connector fits in the slot; when installed in a 16-bit slot, part of the board connector is exposed.*

▼ NOTE *When installed in a 32-bit slot, the Above Board performs best if SIMMs are installed four at a time (as described in the section in Appendix A titled "Determine the size and number of SIMMs to be added").*

9 Insert the Above Board in the selected expansion slot (as shown in Figure 2-1).

- Loosen (but don't remove) the board-retaining screw on the back of the computer and remove the expansion-slot cover.
- Line up the edges of the Above Board so they fit into the card guides.
- Slide the board into the selected slot and press down on it until it seats firmly and evenly in the board connector.
- Tighten the board-retaining screw.

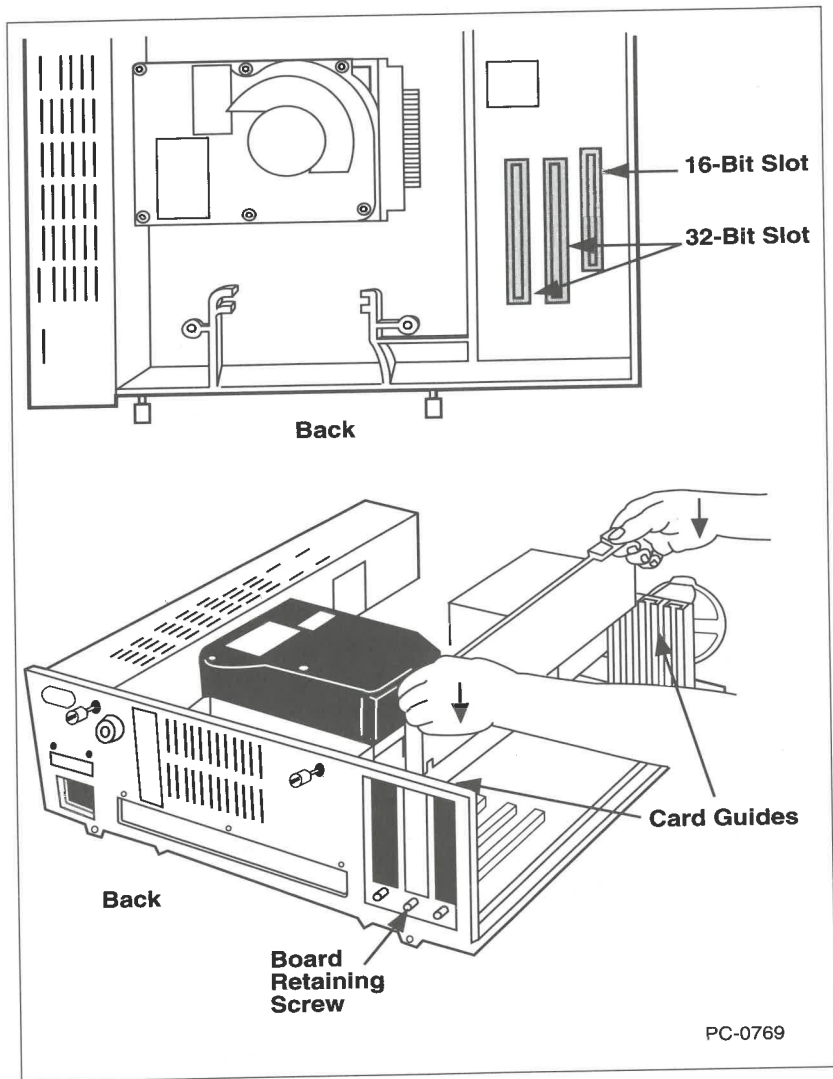


Figure 2-1 *Installing the Above Board*

- 10** Replace the cover or side panel of your computer
- 11** Plug the power cable into the wall outlet.

SET UP YOUR COMPUTER FOR THE ABOVE BOARD

1 Power up your computer using your reference diskette.

▼ **NOTE** *Be sure to use the most recent version of your reference diskette (that is, the one that contains the setup information for any other add-in boards you have installed). If this is a new computer, use the reference diskette shipped with the computer.*

Insert your reference diskette in drive A: and turn on the computer's power switch.

The computer will test its memory and display the results on the screen. Because you have just installed a new board and have not yet updated your computer's configuration, the message

165

will appear on the screen.

The IBM logo appears next. Press ENTER to continue.

2 Answer 'N' to the question "Automatically configure the system? (Y/N)."

3 (Optional step) Make a backup copy of your reference diskette.

If you have a new computer and you have not yet made a backup copy of your reference diskette, choose "Backup the Reference Diskette" from the menu, and follow the on-screen prompts.

4 Copy the Above Board option file from your Intel Option diskette to the reference diskette.

Choose "Copy an option diskette" from the menu and follow the on-screen prompts.

5 Choose "Set configuration" from the Main Menu.

6 Choose "Change configuration" from the submenu.

7 Locate the Above Board entry of the change configuration screen.

Press the arrow keys to scroll through the screen. There is one entry for each slot in the computer.

8 Select a ROM Address for your Above Board ROM.

If the address you choose causes a conflict with another board in your computer, choose any of the addresses given that doesn't cause a conflict.

If you're installing more than one Above Board in your computer, select a ROM Address for one of the boards and leave the addresses for the rest disabled.

▼ NOTE *The Above Board ROM is an electrically-erasable programmable ROM (EEPROM), that contains board setup information.*

9 Select the SIMM speed for the SIMMs on your Above Board.

If your board has 100 ns SIMMs, select 100 ns in the SIMM speed entry; if you have 85 ns, 80 ns, 70 ns, or 60 ns SIMMs, select 85 ns or faster.

▼ CAUTION *If you choose 85 ns or faster when you have 100 ns SIMMs installed, you may corrupt data in your computer. If you're not sure about the speed of your SIMMs, choose 100 ns.*

10 If you have installed an Intel I/O Option on your Above Board, select the port names for your serial and parallel port (as described in your I/O Option installation guide).

11 Save your configuration.

If the ROM Address you selected in step 8 conflicts with another board, you will get a warning message here. Follow the instructions accompanying the warning to return to the change configuration screen to select another address.

12 Reboot your computer from the hard disk.

Follow the on-screen instructions to exit the change configuration screen and reboot your computer. When you're prompted to reboot the system, **remove the reference diskette before you reboot.**

WHERE TO GO FROM HERE

Your Above Board is now installed.

- If you're setting up your Above Board strictly for extended memory, go to the section later in this chapter titled "Check Your Memory."
- If you're currently running your computer under DOS or OS/2 and you wish to set up some of the memory on your Above Board as expanded memory, continue with the next section titled "Run SOFTSET to install expanded memory." Otherwise, go to the section later in this chapter titled "Check Your Memory."
- If you intend to run your computer under OS/2, but OS/2 is not yet installed, install OS/2. (Refer to your *IBM Operating System/2 Standard Edition User's Guide* for installation instructions). Then, if you wish to set up some of the memory on your Above Board as expanded memory, continue with the next section titled "Run SOFTSET to install expanded memory." Otherwise, go to the section later in this chapter titled "Check Your Memory."
- If you intend to run your computer under Xenix, go to the section later in this chapter titled "Check Your Memory."

▼ **NOTE** *If you have both an Above Board 2 Plus and an Above Board MC installed in your computer or if you're replacing an Above Board 2 Plus with an Above Board MC, you must run SOFTSET to remove the iADF file for your Above Board 2 Plus from your hard disk.*

RUN SOFTSET TO INSTALL EXPANDED MEMORY

SOFTSET is a software installation program that helps you set up your Above Board for expanded memory operation. It also helps you set up optional RAM disks and an optional print buffer. **If you intend to use your Above Board to supply extended memory only, skip this section.**

1 Make sure your computer is displaying the DOS prompt.

If not, reboot your computer from your DOS system disk or, if you're running OS/2, select the DOS Compatibility Box.

▼ **NOTE** *SOFTSET adds commands to the AUTOEXEC.BAT and CONFIG.SYS files on your system disk and saves your original files under the names AUTOEXEC.OLD and CONFIG.OLD, respectively. If you already have files named AUTOEXEC.OLD and CONFIG.OLD and you wish to save them, rename them before you run SOFTSET.*

2 Run SOFTSET.

- Insert your copy of the Intel Option diskette into drive A.
- Type the following:

```
A:SOFTSET <ENTER>
```
- Follow SOFTSET's directions and select the options you wish to use. SOFTSET does the rest.

If it's still unclear to you whether you need extended memory, expanded memory, or both, or if you're uncertain what a RAM disk or a printer buffer is, refer to Chapter 3.

3 Press F10 to install the Above Board software on your hard disk.

4 Reboot your computer.

When you reach the SOFTSET exit screen, follow the instructions on the screen to reboot your computer and activate the Above Board software.

▼ **NOTE** *SOFTSET has a set of command-line options that allows you to select some Above Board configuration options directly, without using the selection screen. The section in Appendix D titled "SOFTSET Command" describes SOFTSET's command-line options.*

CHECK YOUR MEMORY

The CHKMEM program reports the amount of conventional, extended, and expanded memory in your computer. It also tells you how much expanded memory is being used and how much is available for application programs.

Running CHKMEM is optional -- it simply confirms the memory choices you made when you installed the Above Board.

The MCATEST program is a memory diagnostics program that checks the memory on any Intel Micro Channel Above Board. You can run MCATEST if the results that CHKMEM reports are not what you expected and you suspect that one of your SIMMs is improperly installed or malfunctioning.

Run CHKMEM (Optional)

▼ **NOTE** *CHKMEM runs only under DOS. If you're using the compatibility box under OS/2, CHKMEM will not run. You must reboot your computer under DOS to run CHKMEM.*

- 1 Make sure your computer is on and displaying the DOS prompt.**
- 2 Make sure the Above Board software is loaded.**

If you just ran SOFTSET and you didn't reboot your computer when you exited SOFTSET, you must reboot your computer (press CTRL-ALT-DEL) to load and activate the Above Board software.

- 3 Run CHKMEM.**

Insert your copy of the Intel Option diskette in drive A, and type the following:

```
A:CHKMEM <ENTER>
```

CHKMEM then displays your memory configuration on the screen.

If the results aren't what you expected

If the amount of memory that CHKMEM displays differs from what you expected, turn to Appendix B and follow the troubleshooting suggestions listed there.

▼ **NOTE** *Some utilities (such as disk caches and RAM disks) allocate extended memory to themselves by removing it from the extended memory pool. If this happens CHKMEM shows less extended memory than is installed in the system.*

▼ **WARNING** *Do not run IBM's advanced diagnostic program to test Above Board memory. The IBM test program isn't compatible with non-IBM memory expansion boards.*

Run MCATEST (Optional)

1 Reboot your computer under DOS.

Use a DOS diskette that does not contain an AUTOEXEC.BAT or a CONFIG.SYS file to reboot your computer.

2 Run MCATEST.

- Insert your copy of the Intel Option diskette in drive A.

- Type the following:

```
A:MCATEST <ENTER>
```

- Select "Test Once" from the MCATEST menu.

MCATEST displays a map of your Above Board, indicating which SIMM sockets have SIMMs installed and which are empty. It then tests the SIMMs. If the test fails, MCATEST indicates which SIMMs failed.

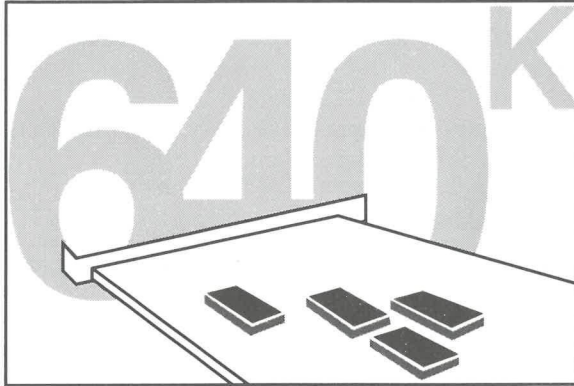
3 When the test is complete, exit MCATEST.

Remove the Intel Option diskette from drive A and follow the instructions on the screen. When you exit MCATEST, it automatically reboots your computer.

MCATEST also has a continuous test mode that allows you to exercise the memory on the Above Board for several hours or overnight. To select this mode, choose "Test Continuously" from the MCATEST menu. MCATEST then begins running its tests repeatedly until a problem is found or you power off the system. A running count of the number of tests completed is displayed at the top of the screen.

The installation and testing of your Above Board is now complete.

Getting the Most from your Above Board MC



Chapter 3

3

GETTING THE MOST FROM YOUR ABOVE BOARD MC

This chapter provides additional information about the Above Board for those who are unfamiliar with memory expansion boards. The subjects covered here include:

- What extended and expanded memory are and which type is appropriate for your applications.
- What a RAM disk is and how to use one.
- What a print buffer is and how to use one.

EXTENDED AND EXPANDED MEMORY

Your Above Board is designed to supply two different types of random-access memory (RAM): extended memory and expanded memory. Extended memory is RAM with addresses above 1M byte in the Intel 80286 and 386 microprocessor's addressing range. Expanded memory is memory that conforms to the Lotus/Intel/Microsoft Expanded Memory Specification (LIM EMS).

(A more detailed description of extended memory and expanded memory is given in Appendix C.)

The Above Board is shipped with all its memory set up for extended memory. The SOFTSET program (described in Chapter 2) allows you to change this setup so that part or all of the memory on the board is used as expanded memory.

How you set up the memory on your Above Board depends on what type of memory your application programs require. The instruction manuals for your application programs should tell you if they use extended or expanded memory. The following sections give some additional guidelines.

When to use extended memory

Set up your board for extended memory if you're running:

- Microsoft Windows 3.0 and only Windows 3.0-based applications, such as Microsoft Word for Windows, Microsoft Excel, Micrografx Designer, Corel DRAW for Windows, Aldus PageMaker, and Ami Professional.
- other DOS programs that are designed to use extended memory, such as Lotus 1-2-3 Rel. 3.1 and Autodesk AutoCAD 386.
- non-DOS operating systems such as OS/2 and Xenix.

When to use expanded memory

Set up your board for expanded memory (using SOFTSET) if you are running DOS application programs that use the LIM EMS version 4.0 (such as WordPerfect, Lotus 1-2-3 Rel 2.2, Borland QuattroPro, Quarterdeck DESQview 386, Ashton Tate dBASE IV v1.1, Central Point PC Tools, Borland SideKick, and Microsoft Windows 2.X).

When to use both extended and expanded memory

Here are several circumstances where you may wish to set up your Above Board for both extended and expanded memory:

- When you are running a combination of DOS applications, some of which use extended memory and others which use expanded memory. How you divide the memory on your Above Board between extended and expanded will depend on the requirements of the applications you intend to run.
- When you are running DOS application programs from the OS/2 compatibility box and some of the DOS programs use expanded memory.

Windows 3.0 allows you to run non-Windows application programs that use expanded memory (such as Lotus 1-2-3 Rel. 2.2). Here, refer to your Windows 3.0 manual for information on setting up your Above Board for extended and expanded memory.

RAM DISKS

Your Above Board software allows you to set up one or more RAM disks. A RAM disk is a program that creates the equivalent of a disk drive in a section of your Above Board's expanded memory.

▼ **NOTE** *The Above Board's RAM disk software (QUIKMEM2.SYS) works only with DOS. If you're running OS/2 or Xenix, you can't use this software. Also, if you're running Windows 3.0, set up your RAM disk through Windows, instead of using QUIKMEM2.SYS.*

You use a RAM disk the same way you use your diskette drive or hard disk drive. It has a drive identification letter and a disk directory. You can store files in a RAM disk and read files from it. You can also store application programs in a RAM disk and run them from there.

The only difference between a RAM disk and an ordinary disk drive is that the data stored in a RAM disk is lost when you power off or reboot your computer. If you want to save the data for future use, you must copy the files in the RAM disk to a diskette or your hard disk before you power off or reboot your computer.

When a RAM disk is useful

The benefit of a RAM disk is that it works much faster than an ordinary disk drive: up to 10 times faster than a diskette drive and twice as fast as a hard disk drive. If you are running an application program that frequently reads from or writes to a disk, you can often speed up the program by running it from a RAM disk.

Creating a RAM disk

The SOFTSET program (described in Chapter 2) lets you create up to two RAM disks. It does this automatically. All you need to do is select the size of the RAM disk in K-bytes from the SOFTSET setup screen.

SOFTSET creates a RAM disk by copying the QUIKMEM2.SYS program to your system disk and placing a DEVICE=QUIKMEM2.SYS command in your CONFIG.SYS file. Then, when you power up or reboot your computer, DOS executes the QUIKMEM2 command to set up the RAM disk in expanded memory. SOFTSET inserts one DEVICE=QUIKMEM2.SYS command in your CONFIG.SYS file for each RAM disk you request.

If you wish to create additional RAM disks or to modify the DEVICE=QUIKMEM2.SYS command line, refer to the section in Appendix D titled "QUIKMEM2 device driver command."

What drive letter is assigned to your RAM disk

The drive identification letters for your RAM disks typically start with D:. However, they may differ, especially if you have network (LAN) software installed on your computer.

DOS assigns a drive letter to a RAM disk at the time the RAM disk is created (that is, at the time DOS executes the DEVICE=QUIKMEM2.SYS command). To do this, DOS finds out how many hard disk drives your computer has and automatically assigns the next available letter to your RAM disk.

For example, if your computer has one hard drive its drive letter is typically C:. The drive letter for your first RAM disk would then be D: and the letter for the second would be E:.

SOFTSET inserts the DEVICE=QUIKMEM2.SYS commands at the end of the CONFIG.SYS file. If you have LAN commands in your CONFIG.SYS file that precede your QUIKMEM2.SYS commands, DOS assigns drive letters to your LAN devices before it assigns them to your RAM disks. If you wish to have your RAM disk drive letters assigned first, you can edit your CONFIG.SYS file to place the DEVICE=QUIKMEM2.SYS commands immediately after the DEVICE=EMM command.

Copying files to a RAM disk

You can copy files to a RAM disk either explicitly (using the DOS COPY command) or automatically (using a batch file). For example, to copy a file called SAMPLE.DOC from diskette drive A: to RAM disk D:, enter the following command from the DOS command line:

```
COPY A: SAMPLE.DOC D: <ENTER>
```

If you have a set of files or programs that you wish to access from a RAM disk, you can use a batch file to copy all these files and programs to the RAM disk automatically. For example, assume you have a program called TIME.EXE and an accompanying data file (TIME.DAT) that you want to run from a RAM disk. By including the following COPY commands in your AUTOEXEC.BAT file

```
COPY C: TIME.EXE D: <ENTER>  
COPY C: TIME.DAT D: <ENTER>
```

you can automatically copy these files from hard disk drive C: to RAM disk D: whenever you power up or reboot your computer.

▼ NOTE

Each RAM disk is limited to 128 files in its root directory. (This is the normal DOS limitation.) If you need to put more than 128 files in a RAM disk, you must create subdirectories on the RAM disk (using the DOS MKDIR command) to hold the files.

Removing a RAM disk

You can remove a RAM disk from your system either by running SOFTSET or editing your CONFIG.SYS file. If you run SOFTSET, set the RAM disk size to zero. SOFTSET then modifies the CONFIG.SYS file to remove the DEVICE=QUIKMEM2.SYS command for that RAM disk.

You can also edit the CONFIG.SYS file directly and delete the DEVICE=QUIKMEM2.SYS command for the RAM disk you wish to remove.

When you've removed the QUIKMEM2 command from your CONFIG.SYS file, reboot your computer to remove the RAM disk. When you reboot the system, all the data currently in the RAM disk is lost.

PRINT BUFFER

Your Above Board software allows you to set up a print buffer in expanded memory. A print buffer is a program that collects text that you've sent to a printer from a word processor, spreadsheet, or other application program. The print buffer receives and stores the text very quickly, then sends it to the printer independently of your application. This frees you to continue using your application while your document is being printed.

When a print buffer isn't useful

If you have any of the following situations, you won't benefit from using the Above Board print buffer:

- If you're running OS/2 or Xenix, don't use the Above Board's print buffer. It only works with DOS.
- If any of your application programs have a built-in print buffer, don't use the Above Board print buffer. Programs such as Microsoft Windows 3.0 and WordPerfect provide their own print buffers.

-
- If your printer has a built-in print buffer large enough to hold your documents, don't install the Above Board print buffer. Laser printers such as the Hewlett-Packard LaserJet and Apple Laserwriter typically provide large print buffers.
 - If your computer is on a network (LAN), don't use the Above Board print buffer.
 - Some printers run slower when they receive text from a print buffer. If this reduced printer speed isn't a reasonable tradeoff for the increased availability of your application, don't install a print buffer.

Creating a print buffer

The SOFTSET program (described in Chapter 2) allows you to set up a print buffer. Using the SOFTSET setup screen, you select the size of the print buffer in K-bytes and the type of printer (parallel or serial).

When setting up the size of your print buffer, allow 4K bytes of memory for each page of text and 256K bytes for each page of graphics in an average document.

SOFTSET creates a print buffer by copying the QUIKBUF2.COM program to your system disk and placing a QUIKBUF2 command in your AUTOEXEC.BAT file. Then, when you power up or reboot your computer, DOS executes the QUIKBUF2 command to set up the print buffer in expanded memory.

If you wish to create your print buffer manually or to modify the QUIKBUF2 command line, refer to the section in Appendix D titled "QUIKBUF2 command."

Using your print buffer

Once QUIKBUF2 is loaded, it remains in memory and is activated automatically anytime you send a print job to your printer. Its operation is transparent to you and your application.

▼ **CAUTION** *If you turn off or restart your computer before your document is printed, you'll lose any portion of the document remaining in the print buffer.*

▼ **NOTE** *You can't use the DOS PRINT command when the Above Board print buffer is installed. If you want to send a file to the printer from DOS, use the command:*

`COPY filename PRN`

The print buffer's command menu lets you control some of your printer's activities. To display this menu, press the PrtSc key on your keyboard.

▼ **NOTE** *Any program that disables the PrtSc key will prevent you from accessing the print buffer command menu. The print buffer will still work, but you won't be able to use the commands in the menu to control the printer.*

The print buffer command menu offers the following options:

Cancel	erases the contents of the print buffer.
PrintScreen	prints whatever was displayed on your screen before you called up the menu.
Pause	temporarily stops the print buffer from sending data to the printer.
Resume	continues printing the document exactly where it left off when you used Pause.
FormFeed	puts a form feed at the end of the data currently in the buffer.
ResetPrinter	empties the Above Board print buffer and resets a parallel printer.

You can't reset a serial printer with software. For serial printers, ResetPrinter empties the Above Board print buffer, leaves the printer alone, and displays an error message.

▼ **HINT** *If a control character causes your parallel printer to print strange characters, run off the end of the page, or stall, the ResetPrinter menu entry returns the printer to normal. Just remember to check the top-of-form and other settings before you resume printing.*

Exit returns you to the program you were using when you pressed the PrtSc key.

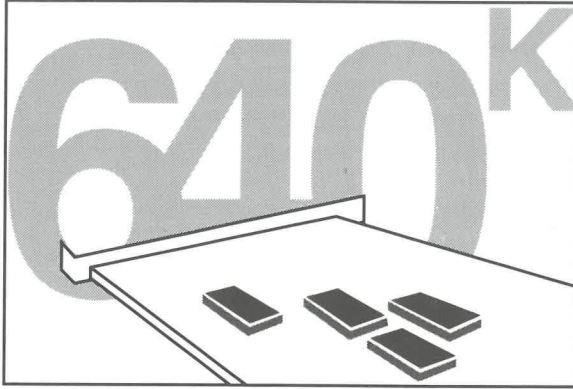
Removing a print buffer

You can remove the print buffer either by running SOFTSET or editing your AUTOEXEC.BAT file. If you run SOFTSET, set the print buffer size to zero. SOFTSET then modifies the AUTOEXEC.BAT file to remove the QUIKBUF2 command.

You can also edit the AUTOEXEC.BAT file directly to delete the QUIKBUF2 command.

After you have changed the AUTOEXEC.BAT file, reboot your computer to remove the print buffer.

Appendixes



Appendixes A-D

A-D

APPENDIX A

ADDING MEMORY TO THE ABOVE BOARD MC

Memory is installed on the Above Board in the form of memory modules, called *SIMMs* (shown in Figure A-1). To add SIMMs to your Above Board, you must perform the following three steps:

- Determine the size, number, and speed of SIMMs to be added.
- Insert the new SIMMs in your Above Board.
- (Optional) Remove the SIMMs currently on your Above Board, if you are adding SIMMs of a different size.

▼ **NOTE** *Not all SIMMs have nine memory chips on them, as shown in Figure A-1.*

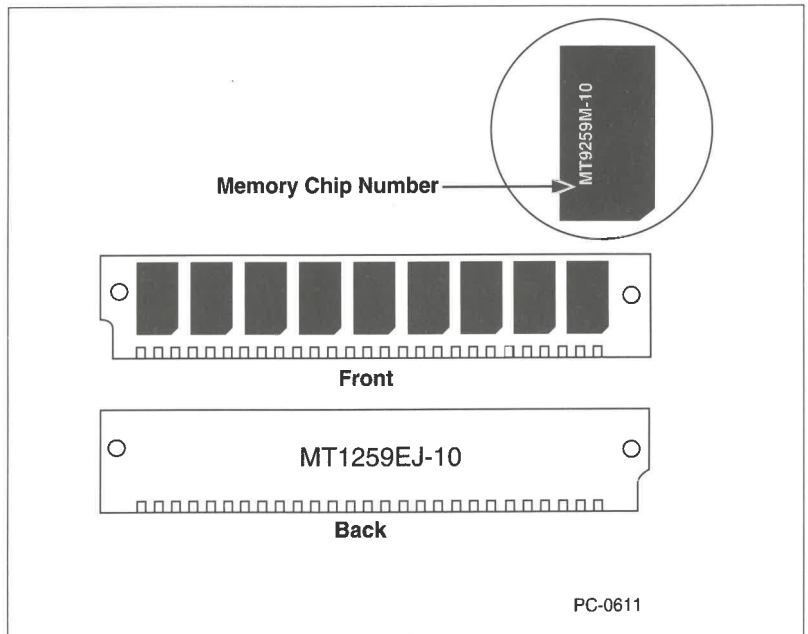


Figure A-1 *Single in-line memory module (SIMM)*

DETERMINE THE SIZE AND NUMBER OF SIMMS TO BE ADDED

The Above Board contains eight SIMM sockets (shown in Figure A-2). You can install 256K-byte, 1M-byte, or 4M-byte SIMMs in these sockets.

▼ **NOTE** *You can't mix SIMMs of different sizes on an Above Board.*

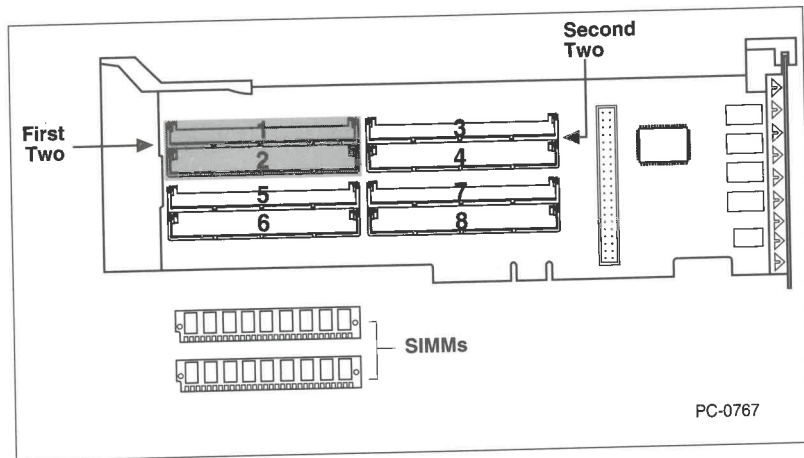


Figure A-2 *Location of SIMM Sockets*

Table A-1 summarizes several restrictions on how you may add memory to your Above Board, depending on

- whether you intend to use the memory on your Above Board as extended memory or expanded memory or both
- the size of the expansion slot in which you're going to install the board (16-bit or 32-bit).

▼ **NOTE** *The 64M-byte limit on extended memory shown in Table A-1 for an Above Board installed in a 32-bit slot is an IBM PS/2 Micro Channel computer limit.*

Table A-1 *Restrictions on how Above Board memory can be used.*

Slot Size	Restrictions
16 Bit	<ul style="list-style-type: none">■ Maximum extended memory: 16M bytes.■ Maximum expanded memory: 32M bytes.■ You must add SIMMs two at a time.■ Any extra memory on an Above Board above 16M bytes of extended memory can be set up as expanded memory.
32 Bit	<ul style="list-style-type: none">■ Maximum extended memory: 64M bytes.■ Maximum expanded memory: 32M bytes.■ You may add SIMMs two at a time up to 16M bytes of total extended memory (all boards in your system), but your board will operate faster if you install the SIMMs four at a time.■ Beyond 16M bytes of extended memory, SIMMs must be added four at a time, for all boards in your computer.■ Any Above Board that is supplying extended memory above 16M bytes must be placed in a 32-bit slot.

If you already have some memory installed on the Above Board, you must add SIMMs that are the same size as those already on the board. If this leaves you with less than the full amount of memory you need on the board (refer to Table A-1), you must remove the existing SIMMs from the board and add the next higher sized SIMMs.

Instructions for removing SIMMs are given later in this appendix in the section titled "Removing SIMMs from the Above Board."

DETERMINE THE SPEED OF SIMMS TO BE ADDED

You can install SIMMs that operate at 100 nanoseconds (ns) or faster. To determine the speed of your SIMMs, check the suffix to the part identification number of the memory chips on the SIMM and refer to Table A-2.

Using SIMMs that are 85 ns or faster allows your Above Board to run with zero wait states for optimum performance.

Table A-2 *Memory Chip part numbers and speed.*

Part No. Suffix	SIMM Speed
-1 or -10	100 ns
-85	85 ns
-8 or -08	80 ns
-7 or -07	70 ns
-6 or -06	60 ns

You can mix SIMMs of different speeds. Here, the speed of the slowest SIMM used determines the performance of your Above Board.

INTEL VERIFIED SIMMS

Most industry standard SIMMs will work in the Above Board. Intel has tested the SIMMs listed in Tables A-3, A-4, and A-5 and verified that they work with the Above Board.

Each SIMM has an identification number on the back (as shown in Figure A-1). Each individual memory chip also has an identification number.

Table A-3 256K-Byte SIMMs that work in the Above Board*

<i>Manufacturer</i>	<i>Chip number</i>	<i>Module number</i>
Fujitsu		MB85227-xx MB85240-xx
Hitachi	HM51256CP	HB561409B-xx
Micron Technology	MT1259EJ-xx	MT9259M-xx
Mitsubishi	M5M4256AJ-xx	MH25609J-xx
NEC	UPD41256-xx	MC41256A9B-xx
NMB	AAA2800J-xx	NM2800J9-xx
Oki	MSM41256AJS-xx MSM51256AJS-xx	MSC2304YS9-xx MSC2331A-xx
Samsung	KM41256-xx	KMM59256-xx
Texas Instruments	TMS4256FML-xx	TM4256GU9-xx

*-xx indicates speed: -1 or -10 means 100 ns parts; -85 means 85 ns parts, -8 or -08 means 80 ns parts; -7 or -07 means 70 ns parts; and -6 or -06 means 60 ns parts.

Table A-4 *1M-Byte SIMMs that work in the Above Board**

<i>Manufacturer</i>	<i>Chip number</i>	<i>Module number</i>
Fujitsu	MB81C1000-xx	MB85235-xx
Intel	T21010-xx	SM21019-xx
Hitachi	HM511000JP-xx	HB56A19B-xx
Micron Technology	MT4C1024-xx	MT8C9024M-xx
Mitsubishi	M5M41000AJ-xx M5M41000BJ-xx	MH1M09A0J-xx MH1M09B0J-xx
NMB	AAA1M100J-xx	MM1M00J9-xx
NEC	UPD421000LA-xx	MC421000A9B-xx
Oki	MSM511000AJS-xx	MSC2312A-xxYS9
Panasonic	MN41C1000SJ-xx	MN4A091M0S-xx
Toshiba	TC511000J-xx TC511000AJ-xx	THM91000S-xx THM91000AS-xx
Samsung	KM41C1000J-xx	KMM591000-xx
Siemens	HYB511000AJ-xx	HYM91000S-xx
Texas Instruments	TMS4C1024DJ-xx	TX024EAD9-xx
Toshiba	TC51000AJ-xx	THM91000AS-xx

*-xx indicates speed: -1 or -10 means 100 ns parts; -85 means 85 ns parts, -8 or -08 means 80 ns parts; -7 or -07 means 70 ns parts; and -6 or -06 means 60 ns parts.

Table A-5 *4M-Byte SIMMs that work in the Above Board**

<i>Manufacturer</i>	<i>Chip number</i>	<i>Module number</i>
NEC	UPD424100LA-xx	MC-424100A9B-xx
Panasonic	MN41C4000SJ-xx	MN4A094M0S-xx
Samsung	KM41C4000J-xx	KMM594000-xx
Siemens	HYB514100-xx	HYM94000S-xx
Toshiba	TC51400J-xx	THM94000S-xx

*-xx indicates speed: -1 or -10 means 100 ns parts; -85 means 85 ns parts, -8 or -08 means 80 ns parts; -7 or -07 means 70 ns parts; and -6 or -06 means 60 ns parts.

REMOVING THE ABOVE BOARD FROM YOUR COMPUTER

Your Above Board must be out of your computer to install new SIMMs. If your board is currently installed in your computer, remove it as follows:

- 1 Turn off the power switch for your computer and disconnect its power cable from the wall outlet.**
- 2 Remove the cover or side panel from your computer.**
- 3 Loosen (but don't remove) the board-retaining screw on the back of the computer.**
- 4 Remove the Above Board from your computer and place it on a static-free surface (such as, the anti-static envelope the board was shipped in).**

INSERT THE SIMMS IN YOUR ABOVE BOARD

▼ **NOTE** *If you need to remove SIMMs from your Above Board before you add new SIMMs, go to the section later in this chapter titled "Removing SIMMs from the Above Board."*

1 Gather the materials you'll need to install the SIMMs.

Arrange your Above Board and the SIMMs you wish to add on a clean, dry, level, and static-free work surface.

▼ **CAUTION** *The Above Board components can be damaged by discharge of static electricity. Placing your board on the anti-static wrapper while you work with it reduces the chance of damaging the board through static discharge. If you have a static-discharge wrist cord, wear it when you handle the board and SIMMs.*

2 Determine where to add the SIMMs.

If you're installing SIMMs two at a time, install the first two in slots 1 and 2 (as shown in Figure A-2) and continue with slots 3 and 4, 5 and 6, and 7 and 8.

If you're installing SIMMs four at a time, install the first four in slots 1 through 4 and the second four in slots 5 through 8.

3 Insert the SIMM in the socket, as shown in Figure A-3.

The chips on the SIMM should be facing toward you. With the SIMM pointing at an angle into the socket, insert the bottom edge of the SIMM into the socket, pressing firmly.

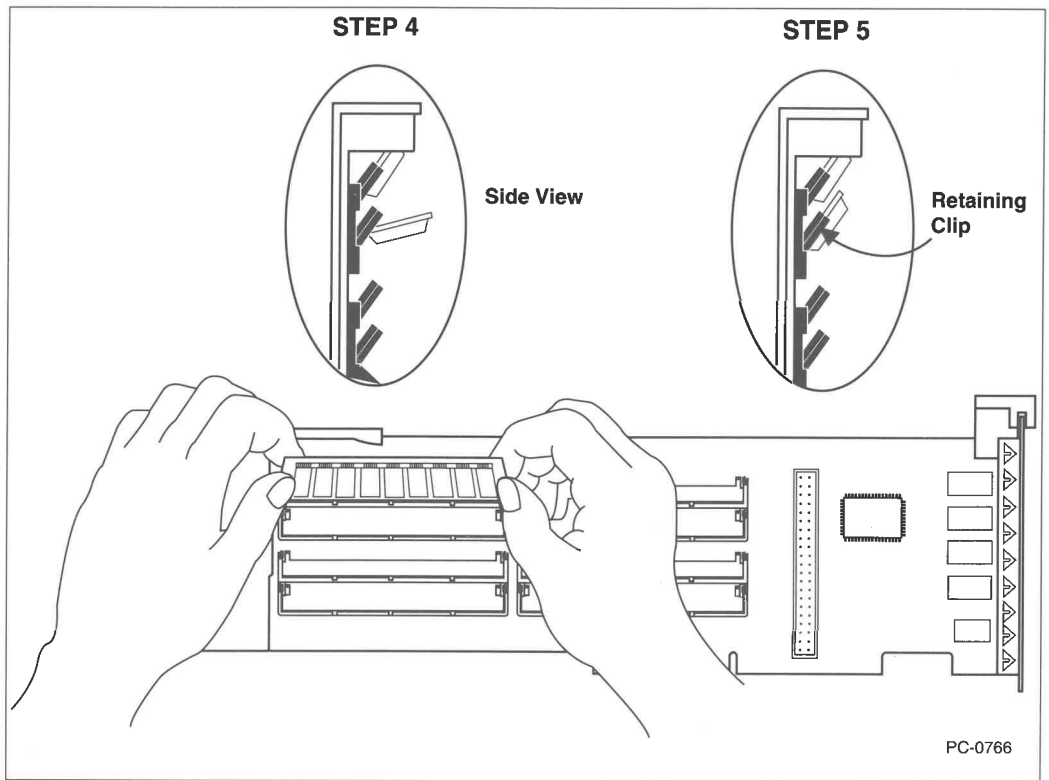


Figure A-3 *Inserting the SIMM*

- 4** Press the top edge of the SIMM toward the board until the retaining clips snap into place (as shown in Figure A-3).
- 5** Make sure the SIMM is seated properly in the socket.

If it isn't, press out on the retaining clips located at the end of the socket (shown in Figure A-4). This will release the SIMM and cause it to move forward, enabling you to remove it from the socket. Once you have removed the SIMM, repeat steps 3 and 4 to reinsert it.

-
- 6 Repeat steps 3 through 5 to insert the remaining SIMMs in the Above Board.**

WHERE TO GO FROM HERE

After you have added the SIMMs to your Above Board, go to Chapter 2 and follow the instructions for installing the Above Board in your system.

REMOVING SIMMS FROM THE ABOVE BOARD

If you need to remove SIMMs from your board before you add new SIMMs, use the following procedure:

- 1 Place your Above Board on a clean, dry, level, and static-free work surface.**
- 2 Orient the board as shown in Figure A-4.**
- 3 Remove the SIMM from the socket.**

Grasp the edges of the SIMM to be removed (as shown in Figure A-4) and press out on the retaining clips located at the end of the socket. This releases the SIMM and causes it to move forward, enabling you to remove it from the socket.

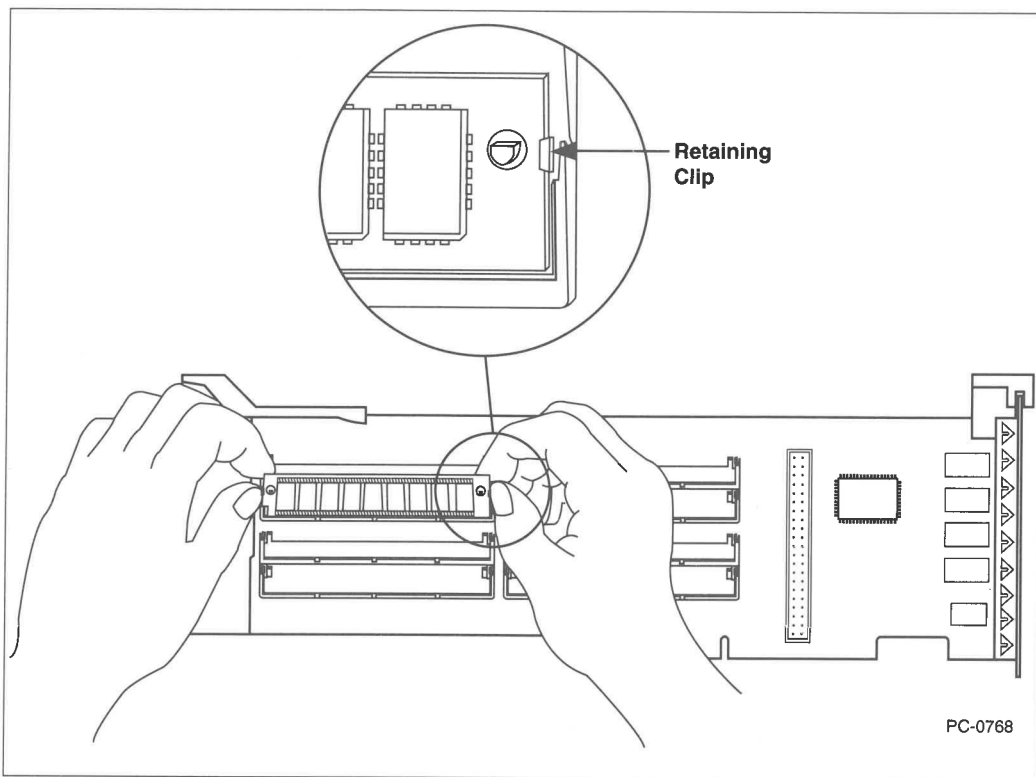


Figure A-4 *Removing a SIMM*

APPENDIX B

IF YOUR ABOVE BOARD MC DOESN'T WORK

This appendix provides troubleshooting information for the Above Board. It gives the most common problems that can cause your Above Board to operate incorrectly and lists possible solutions for each. If you're unable to get your Above Board working correctly using this information, refer to the Customer Support information given at the end of this appendix.

TROUBLESHOOTING INFORMATION

Before you read this section, review the information in the README file on the Intel Option diskette and in the *Read This First* bulletin included with the Above Board. (Instructions for reading the README file are given in Chapter 1.) These documents contain compatibility information that may help you get your board working.

Problem: Memory not recognized or missing memory

Possible solutions:

- Your computer's Power On Self Test (POST) does not see the memory on the Above Board, because the Above Board ROM sets up this memory after POST runs. The Above Board ROM should display the correct memory totals for your computer.
- Check the Above Board for correct installation (seated properly in the expansion slot).
- Ensure that the SIMMs are seated properly in their sockets (pressed down into the socket and snapped into place).

-
- Ensure that the SIMMs are all the same size and are installed in pairs, starting with sockets 1 and 2, and going through sockets 3 and 4, 5 and 6, and 7 and 8. If you have set up your computer for more than 16M bytes of extended memory, each board that contains extended memory above 16M bytes must be in a 32-bit slot and must have SIMMs added in sets of four.
 - Run MCATEST (as described in Chapter 2) to pinpoint missing, misinstalled, or defective SIMMs.
 - If you added SIMMs to your Above Board, ensure that you used industry standard SIMMs. Intel has verified that the SIMMs listed in Tables A-3, A-4, and A-5 operate correctly in an Above Board.
 - Make sure you selected the correct SIMM speed in the change configuration screen when you installed the Above Board.
 - Make sure you entered the correct values when running the SOFTSET program. Remember, if you disabled the memory on your system board (by choosing mappable conventional memory), all your system board memory will be unavailable for use.
 - If you have more than 16M bytes of memory in a 286- or 386SX-based IBM PS/2 Micro Channel computer, you will be missing 128K bytes of that memory. This is normal. IBM's system board disables 128K bytes of system memory in these computers if more than 16M bytes total memory is installed.
 - Check if the ROM on your Above Board is disabled. To enable the ROM, boot your computer from your reference diskette and perform the steps described in Chapter 2 in the Section titled "Set up your computer for the Above Board."
 - If you have two or more Above Boards installed in your computer, the ROM on one (and only one) Above Board must be enabled, as described in the section in Appendix D titled "Installing Multiple Above Boards". The ROM will not execute if more than one is enabled.

Problem: Cannot find adapter descriptor file (ADF)

Possible solution:

- Insert your computer's reference diskette in drive A and restart your computer (press CTRL-ALT-DEL). From the menu, select the "Set Configuration" and "Change Configuration" screens. From the "Change Configuration" screen, locate the slot containing the add-in board that does not have an accompanying ADF. If you are missing the ADF for the Above Board, copy the Intel Option diskette, using the "Copy option diskette" entry from the main menu. Then, configure your computer as described in Chapter 2 in the section titled "Set up your computer for the Above Board."
- If the ADF is missing for another add-in board, copy the option diskette for that board. Then, update your computer's configuration.

Problem: 165 error

Possible solutions:

- You have changed your computer's board configuration (added a board, removed a board, or moved boards to different slots), and have not yet used your computer's reference diskette to update your configuration. It is normal to receive this error during the board installation procedure described in Chapter 2. If your computer still displays this error after you have completed the Chapter 2 installation procedure, repeat the installation procedure starting with the step titled "Set up your computer for the Above Board."

Problem: 164 error

Possible solutions:

- The amount of memory your computer found does not agree with the amount it found the last time you reconfigured your computer with the reference diskette. You can ignore this message and start your computer with its current memory configuration by pressing the F1 key. To correct the error, check the following items.
- Ensure that the SIMMs are all the same size and are installed in pairs, starting with sockets 1 and 2, and going through sockets 3 and 4, 5 and 6, and 7 and 8. If you have set up your computer for more than 16M bytes of extended memory, each board that contains extended memory above 16M bytes must be in a 32-bit slot and must have SIMMs added in sets of four.
- If you have added SIMMs to your Above Board, ensure that you used industry standard SIMMs. Intel has verified that the SIMMs listed in Tables A-3, A-4, and A-5 operate correctly in an Above Board.
- Ensure that the SIMMs are seated properly in their sockets (pressed down into the socket and snapped into place).
- Run MCATEST (as described in Chapter 2) to pinpoint missing, misinstalled, or defective SIMMs.

Problem: 111 error

Possible solution:

- This message can indicate that one or more expanded memory pages are using the same section of the reserved address space as another add-in board, such as a Token Ring board. Read the README file for information on compatibility of the Above Board with other add-in boards.

-
- This error can indicate that some of the Above Board's memory has been mapped in such a way as to overlap some of the system board memory or the memory on another add-in board. Run **SOFTSET** and verify that the extended memory start location is correct. You can also try setting the extended memory start location to **AUTO**, which allows the Above Board ROM to automatically select the start location.
 - This error message occasionally accompanies a 164 error. It indicates a parity error occurred on one of the memory boards installed in your computer. This message could indicate faulty SIMMs or a faulty board.
 - Ensure that the SIMMs are seated properly in their sockets (pressed down into the socket and snapped into place).
 - Check the board for correct installation (seated properly in the expansion slot).
 - Restart your computer (press **CTRL-ALT-DEL**).
 - Run **MCATEST** (as described in Chapter 2) to pinpoint missing, misinstalled, or defective SIMMs.

Problem: 110 error

Possible solution:

- This error message occasionally accompanies a 164 error. It indicates that a parity error occurred on your computer's system board. This could indicate faulty SIMMs on the system board or a faulty system board. However, it could also be caused by improper installation of one or more SIMMs on the system board.
- Ensure that the SIMMs on the system board are seated properly in their sockets (pressed down into the socket and snapped into place).
- Check all the add-in boards for correct installation (seated properly in their expansion slots).

-
- Run MCATEST (as described in Chapter 2) to pinpoint missing, misinstalled, or defective SIMMs.

Problem: 114 error

Possible solution:

- This error indicates that your computer's power-up self test (POST) detected a ROM checksum error. To correct this problem, run SOFTSET in the interactive mode, verify your options, and save your configuration. This operation causes SOFTSET to update the Above Board ROM code.

Problem: ROM error is displayed or is suspected

Possible solutions:

- Run MCATEST. If any ROM errors have occurred, MCATEST displays them automatically when it is run.

Problem: Print buffer is not operating as expected

Possible solutions:

- Put the QUIKBUF2 command last in the AUTOEXEC.BAT file.
- Make sure no other print buffer is being used. If two are being used, remove one.
- If you're using a serial printer, check your AUTOEXEC.BAT file to see that it contains the proper MODE command to set up the printer. Refer to the DOS manual for more information about the MODE command. Refer to the printer manual to determine the appropriate parameters for the MODE command.

Problem: Print buffer message 500. "xx" failed-check printer

Possible solutions:

- The print buffer couldn't do a PrintScreen (2) or FormFeed (5) because the printer wasn't ready.
- Check the printer. Make sure:
 - it has enough paper.
 - it's turned on and is on-line.
 - all cables are plugged in tightly.
- If the error was triggered by a PrintScreen command, make sure the printer is LPT1.
- Pressing any key returns you to the print buffer command menu, where you can either retry the command or exit the menu.

Problem: Print buffer message 507. Can't reset serial printer

Possible solution:

- Your printer is serial and you chose the Reset Printer entry from the print buffer menu. Serial printers can't be reset by software.
- This is an advisory message, not an error message. You aren't required to do anything. The contents of your print buffer have been erased. Pressing any key returns you to the print buffer command menu.

If you're unable to get your Above Board working with the help of this troubleshooting index, contact Intel Customer Support as described in the next section.

CUSTOMER SUPPORT INFORMATION

If you still have any questions or problems, please contact Intel Customer Support, using any of the methods given below.

If you send your comments electronically, be sure to include the following information:

- Your name
- The phone number of your fax machine
- A phone number where you can be reached
- The Product Code and Serial Number of your Intel product
- The type of computer you use
- A list of all the boards or cards in your computer
- Copies of your CONFIG.SYS and AUTOEXEC.BAT files
- The error message, if any, that appears when the problem occurs.

Call the Intel FaxBACK™ document delivery service

If you have a touch-tone phone and a fax machine or fax board such as an Intel SatisFAXtion or Intel Connection CoProcessor board, you can call the FaxBACK order line to rapidly receive up-to-date technical support information—the same information our Customer Support technicians use to solve problems. The information you request is sent to your fax machine or fax board.

From inside the U.S. and Canada, you can reach the Intel FaxBACK order line 24 hours a day by dialing **(800) 525-3019**.

From outside the U.S. and Canada, dial **(503) 629-7576**.

Call the Intel Electronic Bulletin Board

Using a modem, you can access the Intel Electronic Bulletin Board 24 hours a day, to get up-to-date information on Intel products and leave questions for Intel Customer Support technicians. The Bulletin Board also has the latest versions of Intel software that you can download using various transfer protocols.

To reach the Bulletin Board, set your modem for any speed from 300 to 9600 bits per second; 8 data bits; no parity; and 1 stop bit; and call **(503) 645-6275**.

If you subscribe to MCI Mail, you can reach Intel Customer Support by sending your MCI Mail message to **INTEL SUPPORT**.

If you subscribe to CompuServe, you can reach Intel Customer Support through the **Intel Forum (GO INTEL)**.

Send a Fax

If you fax a question or comment to us, please include your name and the information listed at the beginning of this section.

From inside the U.S. and Canada, you can reach our Intel Customer Support fax machine at **(800) 458-6231**.

From outside the U.S. and Canada, call **(503) 629-7580**.

Send a Letter

Mail your comments to the following address:

Intel Customer Support, Mail stop C03-02

5200 NE Elam Young Parkway,

Hillsboro, OR 97124-6497

USA

Call Intel Customer Support directly

If you have a problem that requires immediate attention, you can talk directly to an Intel Customer Support technician. Customer Support representatives are ready to answer your call Monday through Friday, from 7:00 AM to 5:00 PM Pacific time by calling one of the following numbers.

- If you are in the United States or Canada, call **(503) 629-7000**.
- If you are outside the United States or Canada, call **(503) 629-7354**.

You can help your Intel Customer Support representative serve you better and quicker if you have ready access to the following items when you call:

- this manual
- your PC
- your Above Board
- your reference diskette
- your Intel Option diskette

APPENDIX C

HOW EXTENDED AND EXPANDED MEMORY WORK

This appendix explains how extended memory and expanded memory work. Read this section for general information or if you need help solving memory-conflict problems.

DOS ADDRESS SPACE

The DOS operating system was originally designed to run on the Intel 8088 microprocessor. This microprocessor can access a maximum of 1M byte of memory. The 8088's 1M-byte address range is called its *address space*.

DOS divided this 1M-byte address space into two parts (as shown in Figure C-1). The lower 640K bytes of the address space are called *conventional* or *base memory*. This is the area where your DOS application programs run.

The upper 384K bytes are reserved for hardware support. When you add a board (such as a video board) to your computer, the board may use part of this reserved address space.

As programmers began adding more capabilities to DOS application programs, they required more memory. But because DOS reserves the address space above 640K bytes, the 640K-byte conventional-memory limit became a barrier for the development of larger, more complex application programs.

To solve this problem of the 640K barrier, two mechanisms are available: expanded memory and extended memory.

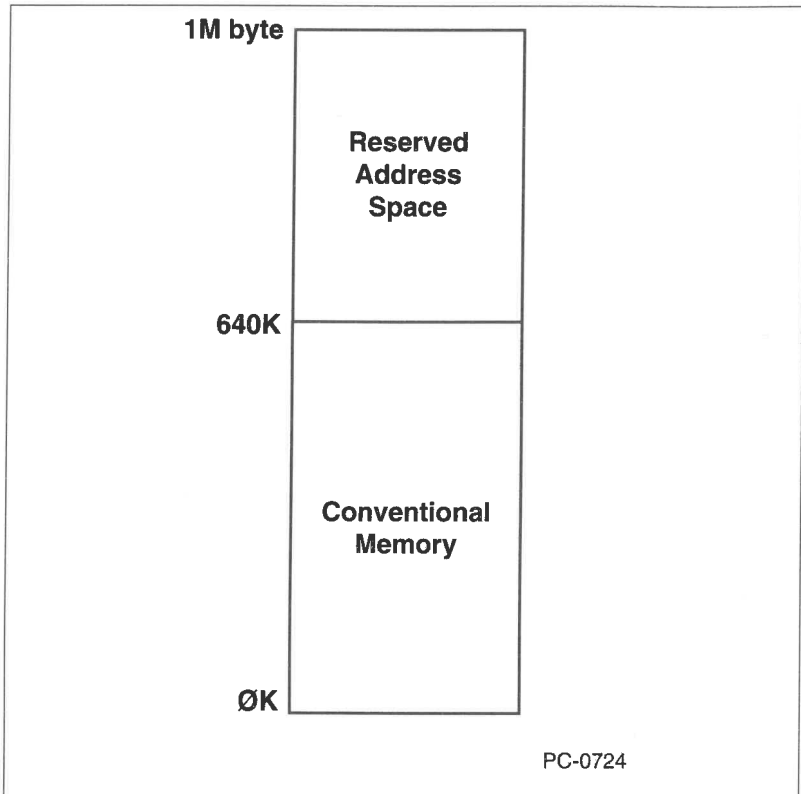


Figure C-1 *DOS address space*

EXPANDED MEMORY

Expanded memory is described in the Lotus/Intel/Microsoft Expanded Memory Specification (LIM EMS). With expanded memory, an application program uses part of the DOS reserved address space to access RAM on a memory expansion board, such as an Intel Above Board (as shown in Figure C-2).

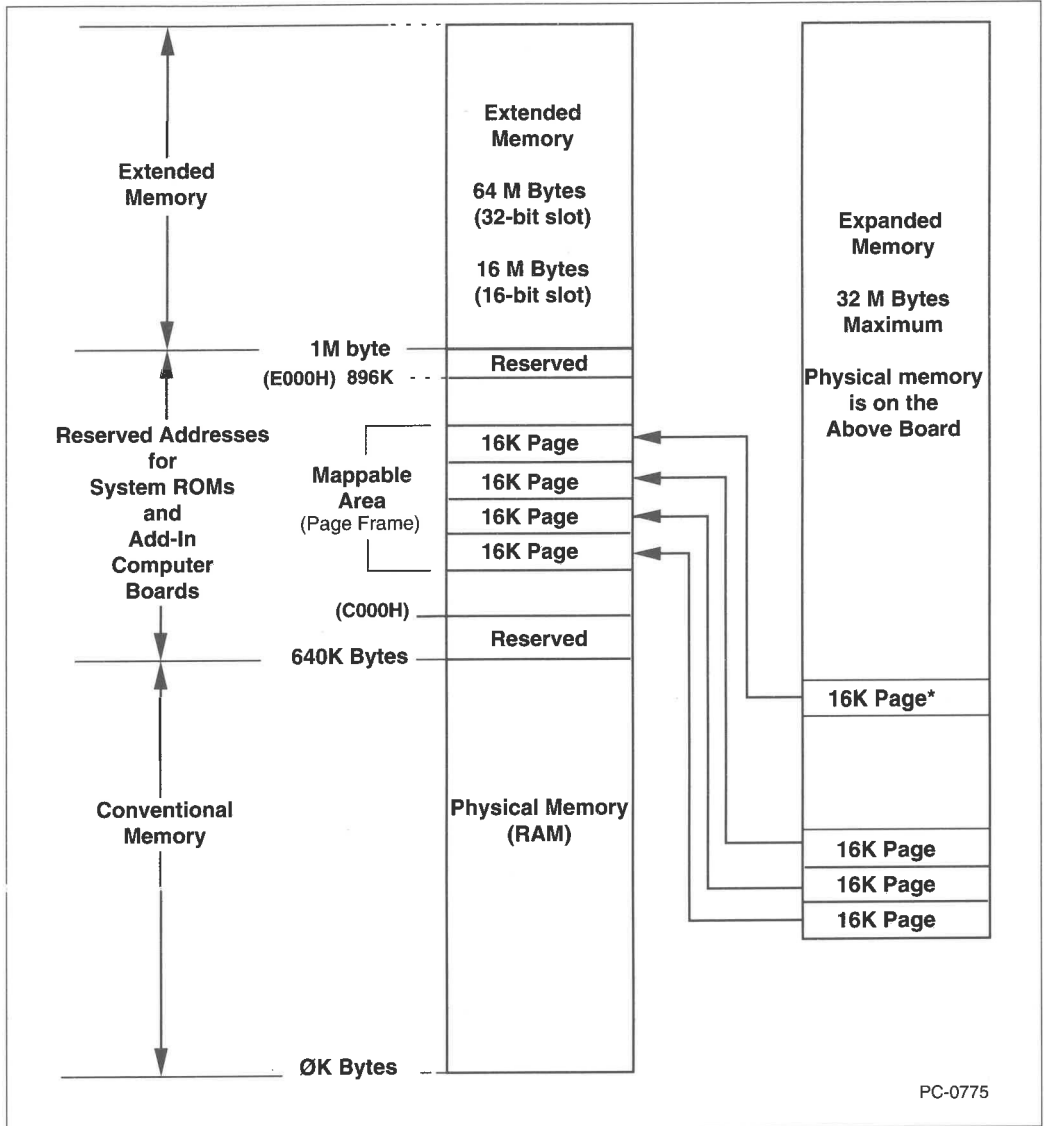


Figure C-2 *Mappable area (page frame) and expanded memory*

* The mapped pages in expanded memory do not have to be contiguous.

The area of the reserved address space used to access expanded memory is divided into 16K-byte sections called pages. A special expanded-memory management (EMM) program maps pages of Above Board expanded memory into pages of the reserved address space. To access expanded memory, an application program then merely writes to or reads from pages in the reserved address space that are mapped to expanded memory on the Above Board.

The LIM EMS requires that at least one contiguous 64K-byte block of the reserved address space be available to EMM for expanded-memory mapping. (This 64K-byte block is called the *page frame*). Typically, the address space used for the page frame is between 768K and 896K. Additional non-contiguous pages of the reserved address space can also be assigned to expanded memory.

The amount of expanded memory that an application can access on the Above Board is not limited to the number of pages of reserved address space assigned to expanded memory. EMM can map any page of Above Board memory into a page in the reserved address space. The technique used to change the mapping of expanded memory pages is called bank switching. EMM commands contained in the application program determine when bank switching should occur. Using bank switching, an application program can access all of the expanded memory on one or more Above Boards (up to a maximum of 32M bytes).

Expanded memory mapping is handled automatically by EMM and application programs that use expanded memory. To use expanded memory, all you need to do is use SOFTSET to set up your Above Board for expanded memory.

Expanded memory conflicts with other boards

EMM attempts to automatically resolve any conflicts that the Above Board may have with other boards that use the DOS reserved address space. When selecting pages for expanded-memory mapping, EMM scans the reserved address space for unused areas. It selects a 64K-byte area of contiguous pages for the page frame, plus any other unused pages. This scan cannot detect all boards that may be mapped into the reserved address space. For example EMM may not find the IBM Token Ring shared RAM address.

In such a case, a conflict occurs when both EMM and another board try to use the same address space. These conflicts can be resolved by telling EMM not to use the area of conflict. This is done by adding the exclude page (EP) parameter to the EMM line of CONFIG.SYS. (Refer to Appendix D for more information on the EMM parameters.)

EXTENDED MEMORY

When Intel 80286 and 386 microprocessors were introduced, the address space available to programs increased to 16M bytes for the 80286 and 4 gigabytes for the 386. The additional address space above 1M byte is commonly called *extended memory* (as shown in Figure C-2).

DOS is still only able to access up to 1M bytes of this available address space. To solve this problem, many application programs (such as, Microsoft Windows 3.0 and Lotus 1-2-3 Rel. 3) now include *DOS extenders* that allow a program to access extended memory.

Also, operating systems like OS/2 and Xenix, which do not have a 1M-byte address space limit, are able to use extended memory.

Most Micro Channel computers have more than 1M byte of memory on their system board. If you have an Above Board, you can allocate all or part of its memory to extended memory. This memory is then added to the extended memory on the system board to form one contiguous area of extended memory.

No special management program (like EMM) is required to manage extended memory. Applications programs that can access extended memory do so directly.

It should be noted that even though the 386 microprocessor offers an address space of 4 gigabytes, IBM PS/2 Micro Channel computers using the 386 only allow you to access 64M bytes of extended memory.

EXPANDED MEMORY AND EXTENDED MEMORY COMPATIBILITY

The concepts of expanded memory and extended memory are not mutually exclusive. You can set up your Above Board to provide both expanded memory and extended memory. You do this by running SOFTSET and selecting the amount of expanded memory you want. The remainder of the memory on the board is then allocated to extended memory.

MAPPING CONVENTIONAL MEMORY

LIM EMS 4.0 enables operating systems or operating environments such as Windows 3.0 and DESQview to map expanded memory into the conventional-memory address range.

Here, an operating environment can map alternate blocks of expanded memory into the conventional memory. These mappable blocks of conventional memory can then be used to create and manage a multitasking environment.

▼ **NOTE** *Mappable conventional memory only works with the IBM PS/2 Models 50, 50Z, and 60, and only when using DOS. EMM won't map conventional memory when using OS/2.*

How to provide mappable conventional memory

To set up mappable conventional memory, run SOFTSET (as described in the section in Chapter 2 titled "Run SOFTSET to install expanded memory") and choose "Yes" for the mappable conventional memory option. The Above Board is then set up to turn off all system board memory and replace it with 640K bytes of Above Board memory.

Two points should be noted when you choose the mappable conventional memory option:

- Whether your system has 1M byte or 2M bytes of memory, all of the system board memory is disabled. Even though you can't use this memory to run programs, at least 1M byte of system board memory must remain in place for use when booting your computer.
- When substituting Above Board memory for conventional memory, the Above Board allocates conventional memory before it allocates extended or expanded memory. As a result, the amount of memory available for expanded and extended memory is 640K bytes less than the total memory on all Above Boards.

APPENDIX D

TECHNICAL INFORMATION

This appendix contains technical information about the Above Board's software and hardware. This information is intended for advanced users who need to set up the Above Board for special installations.

CONTENTS OF THE INTEL OPTION DISKETTE

The Intel Option diskette that comes with the Above Board contains the following files:

@70D1.ADF	ADF for Above Board MC.
SOFTSET.EXE	Sets up your Above Board for expanded memory.
ROM.DAT	A copy of the code for the Above Board MC ROM.
CHKMEM.EXE	Reports the amounts of conventional, expanded, and extended memory used in your computer.
MCATEST.EXE	Performs memory diagnostics on all Intel Micro Channel Above Boards.
EMM.SYS	DOS expanded memory manager.
EMM.EXE	OS/2 expanded memory manager.
EMMSHELL.SYS	OS/2 expanded memory manager device driver shell.
QUIKBUF2.COM	Print buffer.
QUIKMEM2.SYS	RAM disk.

README.BAT	Batch file that loads README text file and SHOW.COM utility.
README.DOC	Contains compatibility and errata information.
SHOW.EXE	ASCII file-scrolling utility that allows you to read the README text conveniently.
@7788.ADF	ADF for Above Board 2 Plus. (Not used with the Above Board MC.)
I7788.DAT	SOFTSET uses this file to create the initializing ADF for the Above Board 2 Plus. (Not used with the Above Board MC.)
POSTEXT.DAT	IBM-supplied POST which recognizes initializing ADFs. (Not used with the Above Board MC.)
BACKUP	Backup subdirectory. The files in this subdirectory are intended for use by Intel-trained technicians.
BACKUPMCINFO.EXE	Shows the current contents of track 0 on your hard disk, as well as some other information about your computer.
BACKUPREST-TRK.EXE	Restores the contents of track 0 on your hard disk. This program can cause loss of data!

FOR SOFTWARE DEVELOPERS

If you're a software developer interested in learning how to create programs that use expanded memory, contact Customer Support (see Appendix B) and ask for a copy of the *Lotus/Intel/Microsoft Expanded Memory Specification*.

ABOVE BOARD ROM

The Above Board uses an electrically-erasable programmable ROM (EEPROM) to store board configuration data and code. (In this guide, the EEPROM is referred to as the ROM.) The configuration data includes

- the amount of expanded memory to be supplied
- an optional extended memory start address
- whether or not mappable conventional memory is enabled
- whether or not the Above Board pauses after ROM errors
- whether the ROM performs normal or abbreviated diagnostics
- whether all Above Board 2 or Above Board 2 Plus boards installed contain 100 ns SIMMs.

When you power up or reboot your computer, the code on the Above Board ROM sets up all the memory on the Above Board MCs, Above Board 2's, and Above Board 2 Pluses installed in the computer according to the configuration data in the ROM. (The Above Board ROM does not affect the configuration of an Above Board MC32.)

If more than two Above Board MCs are installed in a computer, the ROM on only one of the boards is allowed to be enabled.

The configuration data and code in the ROM can be changed or updated by running SOFTSET, as described in the next section.

SOFTSET COMMAND

The SOFTSET program does the following things for you:

- installs the expanded memory manager (EMM) program.
- installs the optional RAM disk program (QUIKMEM2) and print buffer program (QUIKBUF2).

- updates the board configuration data in the Above Board ROM.
- updates the code in the Above Board ROM, if necessary (interactive mode only).
- deletes any initializing ADF files from your hard disk for Above Board 2 Plus boards that are installed in your computer or that were replaced with your Above Board MC.

▼ **NOTE** *You must run SOFTSET to set up your Above Board for expanded memory. This is required because only SOFTSET can update the Above Board ROM.*

SOFTSET offers two modes of operation: interactive and command line. In the interactive mode, SOFTSET provides a setup screen that allows you to select the various expanded memory, RAM disk, and print buffer options. To access this screen, you merely type the following command:

```
SOFTSET <ENTER>
```

When you save the options you selected, SOFTSET updates the configuration data in the Above Board ROM.

In the command line mode, SOFTSET allows you to use any of the following command line parameters:

```
SOFTSET [EXP=x] [EXTF=x/AUTO] [FR=ON/OFF] [MC=ON/OFF]  
[NP=ON/OFF] [INFO] [ND=ON/OFF]
```

When you type the SOFTSET command with one or more of these parameters, SOFTSET bypasses the setup screen and changes the configuration data in the Above Board ROM according to the parameters given. (The parameters are described in the next section.)

These parameters are useful if you need to switch back and forth between two or more Above Board memory settings. Here, you can switch board setups quickly by entering the SOFTSET command and parameters from the DOS command line or by placing the commands in batch files.

If the Above Board ROM code has become corrupted or is out of date, run SOFTSET in interactive mode. SOFTSET will automatically update the ROM code.

SOFTSET parameters

The functions of the SOFTSET parameters are as follows:

EXP= <i>x</i>	Expanded memory amount. Specifies the number of K bytes (<i>x</i>) of Above Board memory to be used as expanded memory. Setting EXP=0 selects all extended memory.
EXTF= <i>x</i>	Extended memory start location. Specifies the address (<i>x</i>) where the extended memory supplied by the Above Board starts. The AUTO value causes Above Board ROM to select this value automatically.
FR	Fast RAM. Sets up the Above Board 2 or 2 Plus for 0 wait state operation. Use this parameter if the SIMMs on your Above Board 2 or 2 Plus are 100 ns or faster. (This parameter does not affect the Above Board MC.)
MC	Mappable conventional memory. Causes memory on system board to be replaced with 640K bytes of Above Board memory. This parameter only works with the PS/2 Model 50, 50Z, and 60, and is ignored when running under OS/2. (Refer to Appendix C for more information about mappable conventional memory.)
NP	No pause. Causes the Above Board MC ROM to continue without a pause after a ROM error or advisory message.

INFO	Information. Displays the current ROM settings and the version numbers for SOFTSET and the ROM.
ND=ON/OFF	No diagnostics. Causes the Above Board ROM to run abbreviated memory tests.

EMM DEVICE DRIVER COMMANDS

When you set up your Above Board to provide expanded memory for your applications, the expanded memory manager (EMM) program provides the interface to your application programs. Two versions of this program are provided on the Intel Options diskette:

EMM.SYS	For systems running under DOS
EMM.EXE	For systems running under OS/2

The following sections explain the command lines and parameters for both versions of EMM.

▼ **NOTE** *If you are configuring all of the memory on your Above Board as extended memory, EMM should not be used.*

Running EMM under DOS

If you set up your Above Board to run under DOS, SOFTSET inserts the following command in the first line of your CONFIG.SYS file:

```
DEVICE=EMM.SYS [computer] [operating system] [EP=x] [RD] [VI]
                [NP] [EXPF=x, EXPL=x] [CP] [H=x] [MCF=x]
                [MCL=x]
```

This command causes the EMM.SYS program to be loaded when your computer is powered up or rebooted. The parameters are described in the following section titled "EMM Parameters."

▼ **NOTE** *You must run SOFTSET to install the EMM command in your CONFIG.SYS file (or in the AUTOEXEC.BAT file for OS/2 installations). This is required, because when SOFTSET installs EMM, it also updates the configuration data in the Above Board MC ROM.*

Running EMM under OS/2

If you set up your Above Board to run under OS/2, SOFTSET inserts the following command in the first line of your AUTOEXEC.BAT file:

```
EMM [computer] [operating system] [EP] [RD] [VI] [NP]  
[EXPF=x, EXPL=x] [CP] [H=x]
```

It also inserts the following command in your CONFIG.SYS file:

```
DEVICE=EMMSHELL.SYS
```

These commands cause the EMM.EXE program to be loaded when your computer is powered up or rebooted. The parameters are described in the following section.

EMM Parameters

Once SOFTSET has installed the EMM command line in your CONFIG.SYS file (DOS installations) or your AUTOEXEC.BAT file (OS/2 installations), you can add parameters to the command line to set up EMM for special situations.

For example, the following command line

```
DEVICE=EMM.SYS MOD50 DOS EP=C000, D800-DFFF  
MCL=9BFF
```

causes EMM to be set up for a DOS installation on a Model 50. The EP parameter causes EMM to exclude the page beginning at C000 and the pages from D800 to DFFF from its search for pages to use for expanded memory mapping. The MCL parameter causes EMM to use address 9BFF as the upper limit for mapping conventional memory.

The following sections describe the EMM.SYS and EMM.EXE parameters. All of these parameters are optional.

The UPPERCASE keyword for each parameter must be entered as shown (in either uppercase or lowercase). The items in italics are variables where you must fill in appropriate values.

Computer parameter

The *computer* parameter defines the type of computer in which the Above Board is installed. The following values are allowed for this parameter:

<u><i>computer</i></u>	<u>Type of computer</u>
MOD50	IBM Personal System/2 Models 50 and 50Z.
MOD55	IBM Personal System/2 Model 55SX.
MOD60	IBM Personal System/2 Model 60.
MOD65	IBM Personal System/2 Model 65SX.
MOD70	IBM Personal System/2 Models 70 and P70.
MOD80	IBM Personal System/2 Model 80.

If you omit the *computer* parameter, EMM will check the system type. If EMM can't identify the computer, it will not install.

Operating system parameter

The *operating system* parameter designates the operating system that you are running under. The following values are allowed for this parameter.

<u>operating system</u>	<u>Type of operating system</u>
DOS	IBM DOS or Microsoft DOS, Version 3.3 and above.
OS2	IBM OS/2.

EMM only works in a DOS or OS/2 environment.

EP=x parameter

The EP=x (exclude pages) parameter allows you to exclude a 16K-byte page or group of pages from the expanded memory page mapping area.

If you omit the EP parameter (or EXPF and EXPL parameters), EMM automatically searches the address range from C000 to DFFF for the presence of ROM or RAM. It then selects all the available pages in this range for page mapping.

The EP parameter lets you exclude a page that is not available for page mapping but that EMM was not able to automatically exclude (such as a ROM that is not turned on when EMM is performing its RAM/ROM check).

The argument for this parameter is a list of starting page addresses or address ranges separated by commas. (The starting addresses for the pages that can be excluded are C000, C400, C800, CC00, D000, D400, D800, and DC00.) Refer to the section earlier in this chapter titled "EMM parameters" for an example of the EP parameter.

Any end-of-range arguments to EP are rounded down to the nearest page boundary. For example, the parameter EP=C000-C7FF excludes the two pages starting at C000 and C400. This allows you to specify the true ending address of a page.

RD parameter

The RD (relocate driver) parameter causes EMM to be installed in expanded memory instead of conventional memory. Using this parameter conserves conventional memory. If the RD parameter is absent, EMM is loaded into conventional memory.

VI parameter

The VI (view configuration) parameter causes EMM to display configuration information and a memory map when EMM loads.

When the VI parameter is used, EMM pauses until you press a key after the configuration information has been displayed. To eliminate this pause, include the NP parameter in your EMM command line.

NP parameter

The NP (no pause) parameter tells EMM **not** to pause after an EMM error or advisory message. If NP is absent, EMM displays each advisory or error message as it occurs and waits for you to press a key to continue.

EXPF=*x* and EXPL=*x* parameters

The EXPF=*x* (expanded first) and EXPL=*x* (expanded last) parameters limit the area (in the reserved address space) that EMM will search for pages to use in expanded memory page mapping. (These parameters perform the same function as the EP parameter, but in a different way.)

The EXPF parameter specifies the first page to search and the EXPL parameter specifies the last page to search. (The starting addresses for the pages that can be specified are C000, C400, C800, CC00, D000, D400, D800, and DC00.)

▼ **NOTE** *The specified range must span at least one 64K-byte area of contiguous, free pages for a page frame.*

EMM rounds EXPF arguments up to the nearest page boundary and rounds EXPL arguments down to the nearest page boundary. Rounding EXPL down allows you to specify the true ending address of a page. For example, either EXPL=D400 or EXPL=D7FF can be used to specify the page starting at address D400 and ending at address D7FF.

You can include either or both of the EXPF and EXPL parameters. If you include both, EMM searches the specified page range and selects all the unused pages for page swapping.

If you include just the EXPF parameter, EMM searches the area from the page specified with the EXPF parameter to DFFF. If you include just the EXPL parameter, EMM searches the area from C000 to the page specified with the EXPL parameter.

CP parameter

The CP (contiguous pages) parameter forces EMM to set up a page mapping area that contains only contiguous pages. This parameter is provided for use with applications that require a contiguous page frame.

H=x parameter

The H=x (handle count) parameter lets you specify the number of handles EMM needs to support. A handle is a value that EMM assigns and uses to identify a block of expanded memory requested by an application program. The default number of handles is 64.

The resident size of the EMM program is based on the number of handles supported. Specifying an EMM handle count less than the default value of 64 can save conventional memory (approximately 40 bytes per handle) and allow EMM to run slightly faster.

Application programs written to use EMM versions earlier than 4.0 use a maximum of 32 handles. If you're using older application programs, you might want to use H=32 to save memory. In this case, reducing the number of handles from 64 to 32 saves approximately:

$$32 \text{ handles} \times 40 \text{ bytes per handle} = 1280 \text{ bytes}$$

However, using the default of 64 handles works fine. The maximum value for x is 255 handles.

MCF= x and MCL= x parameters

The MCF= x (mappable convention first) and MCL= x (mappable convention last) parameters limit the range of conventional memory that is mapped from expanded memory.

▼ **NOTE** *The Above Board mappable conventional memory option only works with the PS/2 Model 50, 50Z, and 60, and is ignored when running under OS/2. (Refer to Appendix B for more information about mappable conventional memory.)*

With the Above Board MC, you must enable mappable conventional memory using SOFTSET before the MCF and MCL parameters take effect.

The MCF and MCL parameters determine the range of conventional memory addresses that are mappable. For example, the following EMM command allows operating environments to map the conventional memory range from 4000 to 9BFF. The valid range for mappable conventional memory is 0 to 9FFF.

EMM MCF=4000 MCL=9BFF

▼ **NOTE** *With virtually any Micro Channel computer, if you map conventional memory, MCL must be set to 9BFF.*

EMM rounds MCF arguments up to the nearest page boundary and rounds MCL arguments down to the nearest page boundary.

EMM parameters used with other Intel Above Board products

The following EMM parameters can be used in addition to the parameters described earlier in this appendix if you are using EMM with an Intel Above Board 2 or Above Board 2 Plus. These parameters are ignored if you have an Above Board MC installed.

EXP= <i>x</i>	Expanded memory amount. Specifies the number of K bytes (<i>x</i>) of Above Board memory to be used as expanded memory.
EXTF= <i>x</i>	Extended memory start location. Specifies the address where the extended memory supplied by the Above Board starts.
FR	Fast RAM. Selects 0 wait state operation for an Above Board 2 or Above Board 2 Plus. All the SIMMs on the board must be 100 ns or faster to use this parameter.
ND	No diagnostics. Causes EMM to run abbreviated memory tests.
RM= <i>x</i>	Reserved memory address. Specifies the memory address for SoftPROM and overrides EMM's autosearch. (Used only in OS/2 installations.)
MC	Mappable conventional memory. Turns off all memory on system board and replaces conventional memory with 640K bytes of Above Board memory. This parameter only works with the PS/2 Model 50, 50Z, and 60, and is ignored when running EMM under OS/2. (Refer to Appendix B for more information about mappable conventional memory.)

QUIKMEM2 DEVICE DRIVER COMMAND

The QUIKMEM2.SYS device driver command creates a RAM disk in expanded memory.

▼ **NOTE** *QUIKMEM2.SYS only works under DOS.*

To create a RAM disk, you must do two things: (1) copy the QUIKMEM2.SYS program from the Intel Option diskette to the root directory of your hard drive and (2) include the following QUIKMEM2.SYS command in your CONFIG.SYS file, in the line after your EMM command:

```
DEVICE=QUIKMEM2 .SYS x
```

The *x* parameter gives the size of the RAM disk in K bytes and must be a multiple of 16. (16 is the minimum value allowed for *x*.) Values that aren't multiples of 16 are rounded up to the next-highest multiple of 16. The maximum size of a RAM disk is 8M bytes, so the *x* parameter can be no larger than 8192.

You can use SOFTSET to set up two RAM disks for you, automatically. Here, SOFTSET creates the necessary DEVICE=QUIKMEM2 commands for the RAM disks in your CONFIG.SYS file and copies the QUIKMEM2.SYS program to your hard disk. If you wish to have more than two RAM disks, you need to edit your CONFIG.SYS file and add the necessary QUIKMEM2 command lines.

QUIKMEM2 example

To create two 1600K-byte RAM disks in expanded memory, place these two lines in the CONFIG.SYS file after the EMM command:

```
DEVICE=QUIKMEM2 .SYS 1600  
DEVICE=QUIKMEM2 .SYS 1600
```

DOS assigns a unique drive letter to each RAM disk. It limits you to 26 drives, which includes floppy drives and hard disks as well as RAM disks. For a typical computer with a hard disk, the first RAM disk is drive D:. DOS assigns letters to additional RAM disks sequentially from D:.

QUIKBUF2 COMMAND

The QUIKBUF2 command creates a print buffer in expanded memory. It also provides a print buffer command menu that allows you to control some of your printer's activities. (The command menu and its commands are described in Chapter 3.)

▼ **NOTE** *QUIKBUF2 only works under DOS.*

To set up a print buffer, you must do two things: (1) copy the QUIKBUF2.COM program from the Intel Option diskette to the root directory of your hard drive and (2) include the QUIKBUF2 command in your AUTOEXEC.BAT file as follows:

```
QUIKBUF2 c SIZE=x d t
```

▼ **NOTE** *You can have only one print buffer. If a print buffer command already exists in your AUTOEXEC.BAT file, delete that command before adding the QUIKBUF2 command.*

You can use SOFTSET to set up a print buffer for you, automatically. Here, SOFTSET creates the QUIKBUF2 command line for you in your AUTOEXEC.BAT file and copies the QUIKBUF2.COM program to your hard disk.

QUIKBUF2 parameters

The QUIKBUF2 parameters are described in the following sections. All of these parameters except the *t* parameter are mandatory.

c parameter

The *c* parameter tells the QUIKBUF2 program what type of computer you're using. The choices for the *c* parameter are:

- | | |
|-------|------------------------------------|
| MOD50 | For the IBM PS/2 Model 50 and 50Z. |
| MOD55 | For the IBM PS/2 Model 55SX. |

MOD60	For the IBM PS/2 Model 60.
MOD65	For the IBM PS/2 Model 65SX.
MOD70	For the IBM PS/2 Model 70.
MOD80	For the IBM PS/2 Model 80.

Size= x parameter

The SIZE= x parameter specifies the amount of expanded memory to reserve for the print buffer software in K bytes. The value of x must be 32 or greater. Any value that isn't a multiple of 16 is rounded up to the next-highest multiple of 16.

The amount of memory used for the print buffer will be 16K bytes less than the amount you specify for x . QUIKBUF2 uses the 16K bytes to save the contents of the screen when the print buffer menu is displayed. So, if you specify the minimum print buffer size ($x=32$), 16K bytes will be used for the print buffer and 16K bytes will be reserved for the program. To set up a 32K-byte print buffer, set the x parameter to 48.

t parameter

The t parameter indicates the type of I/O port to be buffered. The choices are:

P	Parallel (LPT1, LPT2, or LPT3)
S1	Serial (COM1)
S2	Serial (COM2)

If you choose P, either the first print job you run or the print buffer commands you use will determine whether the buffered port is LPT1, LPT2, or LPT3. If you omit the t parameter, the print buffer defaults to parallel.

If you choose an S1 or S2 as the type of port to be buffered and you have not had a printer connected to those ports before, you may need to add MODE commands to your AUTOEXEC.BAT file to establish the correct serial communications protocol. Refer to your DOS manual for an explanation of the MODE command.

QUIKBUF2 example

Assume you have an IBM PS/2 Model 50 and you wish to allocate 176K bytes of expanded memory for the print buffer program (160K bytes for the print buffer itself and 16K bytes for the video display buffer). Also, assume you want to print your data on a serial printer attached to COM1. To obtain this print buffer setup, use the following command:

```
QUIKBUF2 MOD50 SIZE=176 S1
```

INSTALLING MULTIPLE ABOVE BOARDS

All of the Intel Micro Channel Above Boards (Above Board 2, Above Board 2 Plus, Above Board MC32, and Above Board MC) are compatible with one another and can be installed along side each other in a Micro Channel computer.

When installed in the same computer with an Above Board 2 or Above Board 2 Plus, the Above Board MC controls the configuration of all the Above Boards. When installed with an Above Board MC32, the Above Board MC does not control the configuration of the Above Board MC32.

When two or more Above Board MCs are installed in a system, you must disable the Above Board MC ROM on all but one of them. You do this through the system configuration program supplied on the computer's reference diskette. To access this program for an IBM computer, boot your computer from the IBM Reference diskette and select "Set configuration" from the Main Menu and then "Change configuration."

With the change configuration screen displayed, use the arrow keys to locate the configuration information for each Above Board MC. Then, locate the ROM address entry for each board. The ROM Address can be set to C800, CC00, D000, D400, D800, DC00, or disable.

Choose one of the Above Board MCs as the master and select a ROM address for it. Then, disable the ROM address for each of the remaining Above Board MCs installed in your computer.

Save the configuration you selected, then follow the directions on the screen to exit.

If any of these boards are installed with an Above Board MC, SOFTSET and the Above Board MC ROM will configure all the boards.

ABOVE BOARD MC HARDWARE

The basic hardware specifications for the Above Board MC are shown below.

Power consumption	Not to exceed 1.6 amps at +5.0 volts.								
Number of slots	One full-length Micro Channel expansion slot; either 16-bit or 32-bit.								
Memory capacity	Eight SIMM sockets support up to 32M bytes of memory, depending on the size of SIMMs used:								
	<table><thead><tr><th><u>SIMM Size</u></th><th><u>Memory Capacity</u></th></tr></thead><tbody><tr><td>256K Byte</td><td>2M Bytes</td></tr><tr><td>1M Byte</td><td>8M Bytes</td></tr><tr><td>4M Byte</td><td>32M Bytes</td></tr></tbody></table>	<u>SIMM Size</u>	<u>Memory Capacity</u>	256K Byte	2M Bytes	1M Byte	8M Bytes	4M Byte	32M Bytes
<u>SIMM Size</u>	<u>Memory Capacity</u>								
256K Byte	2M Bytes								
1M Byte	8M Bytes								
4M Byte	32M Bytes								
Acceptable memory modules	Refer to Tables A-2, A-3, and A-4								
DMA	IBM PS/2 Micro Channel computers allow DMA up to 16M bytes of extended memory.								

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