

**Kingston Technology  
KTM609/16  
Memory Expansion  
for IBM PS/2 Model 50,  
50z, 55sx, 60, and 65sx**

**KTM-609/16**  
**Memory Expansion Board**  
**for**  
**IBM PS/2 Models**  
**50, 50z, 55sx, 60, and 65sx**

**Installation Guide**

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## Introduction

Kingston Technology welcomes you to the growing family of IBM PS/2 users who have chosen Kingston Memory Expansion options for their computers. As application programs expand in size and complexity, the need for efficient and reliable memory expansion becomes critical. Our aim is to provide you with high quality memory expansion products that give maximum performance benefits at an affordable cost. We have engineered our memory products to be durable, reliable, and trouble-free; and we are confident that you will receive optimum performance from this Kingston product for many years to come.

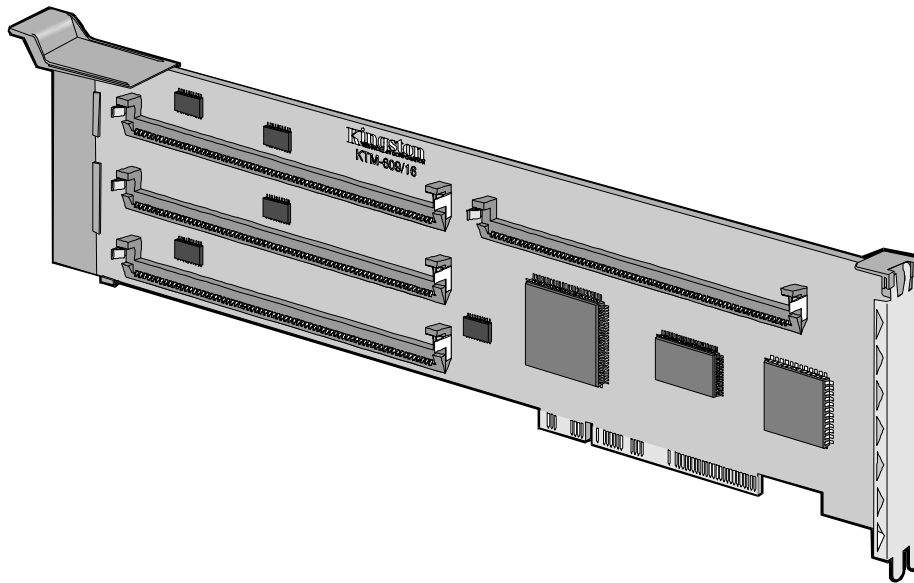
The information in this manual will guide you through the process of placing the memory modules on the circuit board, installing the circuit board inside your computer, and configuring the necessary software to recognize the new memory. Please take a few moments to read through this manual now and familiarize yourself with the procedures you will need to follow when you install the Kingston board and software. This can save you a lot of anxiety later on.

We have tried to anticipate many of the problems that may arise during the installation, and most of your questions will be answered by reading this manual. However, if you encounter a situation that you cannot resolve, or have questions regarding the installation or use of this product, please call Kingston Technical Support at (714) 435-2639. Our main goal is customer satisfaction.

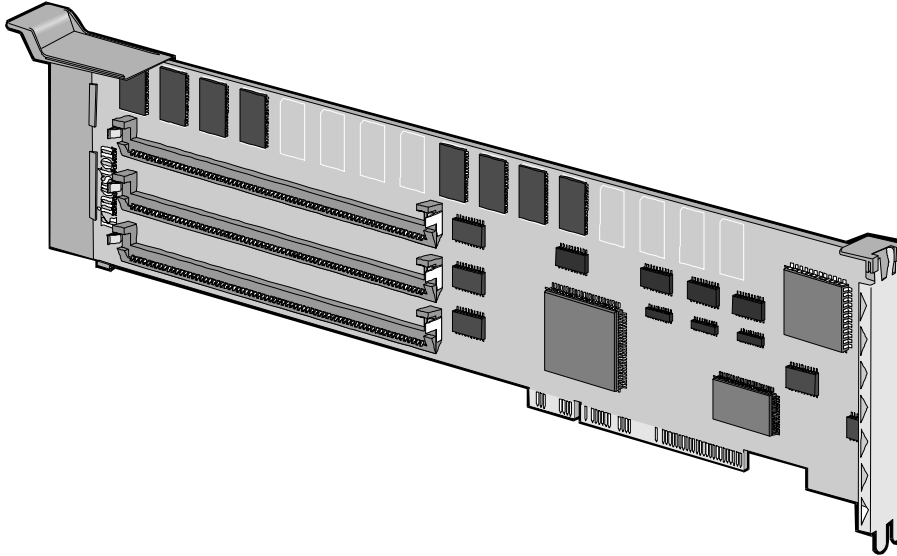
## General Description

The Kingston Technology KTM-609/16 Memory Expansion Board is capable of adding up to 16MB of Random Access Memory to IBM PS/2 Models 50, 50z, 55sx, 60, and 65sx personal computer systems. There are three models of the KTM609/16: Type I has four SIMM sockets with no memory soldered directly to the board; Type II has 4MB soldered and three sockets for expansion; and Type III has 8MB soldered with two sockets available. Single In-line Memory Modules (SIMMs) can be plugged into the SIMM sockets on the KTM-609/16 board, and can be combined in a wide variety of memory configurations. The KTM-609/16 board can be installed in any 16-bit expansion slot on the PS/2 system board.

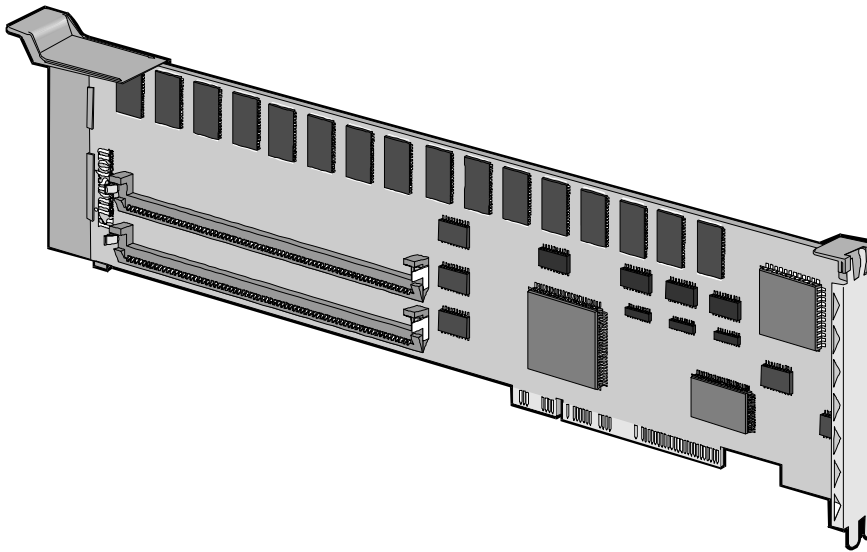
The KTM-609/16 Memory Expansion Board (shown in Figures 1, 2, and 3) support both Extended (linear) memory and Expanded (paged) memory. It adheres to the Lotus/Intel/Microsoft Expanded Memory Specification (LIM) version 4.0 software to enable memory paging. EMS 4.0 is compatible with applications written for EMS 3.2 and Enhanced Expanded Memory Specification (EMMS). Use Extended memory for today's latest software to run under Microsoft Windows® and IBM OS/2®.



*Figure 1: KTM609/16 Type I - 0MB soldered, 4 SIMM Sockets*



*Figure 2: KTM609/16 Type II - 4MB soldered, 3 SIMM Sockets*



*Figure 3: KTM609/16 Type III - 8MB soldered, 2 SIMM Sockets*



## Package Contents

In addition to this manual, you should also receive the following items:

- One KTM-609/16 Memory Expansion Board
- One or more Single In-line Memory Modules (SIMMs), if applicable.
- One Kingston Option Diskette

If any item is missing or damaged, contact the Kingston dealer or distributor from whom you purchased this upgrade.

## Packaging Materials

Kingston memory boards are shipped in an anti-static plastic bag, inside a cushioned box, which protects them from shock and static electricity that could cause severe damage to the memory chips. Before you remove any memory component from its packaging, be sure you discharge any static electricity by touching a securely grounded metal object. Also, keep magnetized tools, such as magnetic screwdrivers, away from the board and memory modules.

## Order Information

Kingston Part #	IBM Part #	Description
KTM-1000/M70	6450603	1MB SIMM
KTM-2000/M70	6450604	2MB SIMM
KTM-4000/M70	34F2933	4MB SIMM
KTM-609/16	6450609	16MB Memory Board

## Before You Begin

Read through this manual before you begin installing the KTM-609/16 board, so you'll know what to expect as you go along. Although this is a relatively easy installation, you may feel more comfortable asking your local Kingston dealer or computer service center to do it for you. There will undoubtedly be a fee associated with doing this, but your peace of mind may be worth the cost.

Pay special attention to Appendix A, "Extended vs. Expanded Memory." If your computer uses DOS, you will have to decide how much of your added Kingston memory to allocate as Extended (linear) memory, and how much to allocate as Expanded (paged) memory. If your computer uses Windows or OS/2, all added memory should be allocated as Extended since Windows and OS/2 can address all added memory directly. Also, if your PS/2 has a 386SX microprocessor or higher, it is best to allocated all added memory as Extended. If Expanded memory is required, use a 386-level Expanded Memory Manager, such as DOS's EMM386.EXE, located in your DOS or WINDOWS directory with the RAM switch. Consult your DOS manual for details.

Besides the contents of the KTM-609/16 memory upgrade package described earlier, you will also need to prepare a backup copy of your IBM PS/2 Reference Diskette. (Follow the instructions in the IBM PS/2 Quick Reference Manual to make the back up copy if you don't already have one.) You will also need a flat-tip, non-magnetic screwdriver for the installation process.

Allow plenty of time for the installation and configuration process. It should take very little time, but if you rush yourself, errors and set-backs are more likely to occur. We want this process to go smoothly for you, so have patience and use caution.

# Software Installation

## Installation Overview

Here is a quick look at the steps you will need to take to install the KTM-609/16 board:

- Check the contents of the KTM-609/16 package.
- Running INSTALL to copy files to your backup Reference diskette.
- Install SIMMs on the KTM-609/16 board.
- Install the KTM-609 board in your PS/2.
- Configure the board and allocate memory.
  - If your operating system is Windows or OS/2, or if all new memory was allocated as Extended, you're finished. STOP HERE.
  - If all or part of new memory was allocated as Expanded, install the Kingston EMS driver. Now you're finished. STOP HERE.

## Updating Your Backup Copy of the Reference Diskette

It is recommended that you **never use your original IBM®** Reference diskette when installing hardware. If you do not have a backup copy disk, follow the instructions below to make a backup copy of your IBM Reference Diskette:

1. Boot from your most current Reference diskette.
2. From the Main Menu, select "*Backup the Reference Diskette.*"
3. Follow the instructions until the process has completed.

The KTM-609/16 package includes a Kingston Option Diskette. This diskette contains configuration files which enable your system to recognize the KTM-609/16. There is an installation program on the Kingston diskette. Use this program to copy the Kingston option files to your backup IBM Reference diskette.

## Running the INSTALL Program

The Kingston Option diskette includes an **INSTALL** program which **MUST** be run to correctly install the configuration files to your backup Reference diskette. If you run "Copy an option diskette" from the IBM Reference Menu, it will recognize the KTM-609 in its system configuration, but will not install the memory correctly.

**You must run the INSTALL program from the Kingston Option diskette to copy the Kingston files to your backup Reference diskette or the configuration will not complete successfully.**

**Do NOT use "Copy an option diskette" from the Reference Menu.**

Before you start, have both the Kingston Option diskette and your backup copy Reference diskette ready. This portion of the installation requires the use of DOS. If you are running OS/2, opening a DOS window will satisfy this requirement. If you use an operating system that cannot emulate DOS, boot your system from a DOS diskette.

The following steps show you how to install the option files from the Kingston diskette to your backup copy Reference diskette.

1. Turn on or reboot your computer (from hard disk or bootable DOS diskette) and get to the DOS prompt.
2. Remove the boot diskette from drive A, if present, and insert the Kingston Option diskette. At the prompt, type:

**A:** [Enter]

3. To start the **INSTALL** program, type:

**INSTALL** [Enter]

You will see the following display on your computer screen:

```
INSTALLATION Version 1.30
(C) Copyright 1990, 1992 KINGSTON TECHNOLOGY CORPORATION

F1  Install Configuration Files onto Reference Diskette
F2  Install KEMM.SYS EMS Driver onto a Working Disk.
F3  Change Existing EMS Driver Parameters
F4  Exit and Back to DOS
```

4. Select [F1] to copy the Kingston Option files to your backup Reference Diskette

Now that you have updated your backup Reference diskette with the Kingston option files, you are now ready to install the KTM-609/16 memory board into your machine.

## Hardware Installation

The KTM-609/16 memory board uses IBM standard 72-pin SIMMs and, in some cases, the memory may already be installed or soldered to the board. If you do not plan to add or remove any SIMMs, you can skip this section and go to "*Installing the KTM-609/16 Board.*"

### Installing the SIMM Modules

The KTM-609/16 board has 3 board types for memory configurations. Type I has four sockets labeled P1, P2, P3, and P4 with no memory soldered to the board. Type II has 4MB soldered and three available sockets to add additional SIMM modules. Type III has 8MB soldered and two additional sockets for adding SIMM memory modules. All three board types support up to 16MB of memory.

<b>KTM-609/16 Board</b>	<b>Soldered Memory</b>	<b>SIMM Sockets</b>
Type I	0MB soldered	4 sockets
Type II	4MB soldered	3 sockets
Type III	8MB soldered	2 sockets

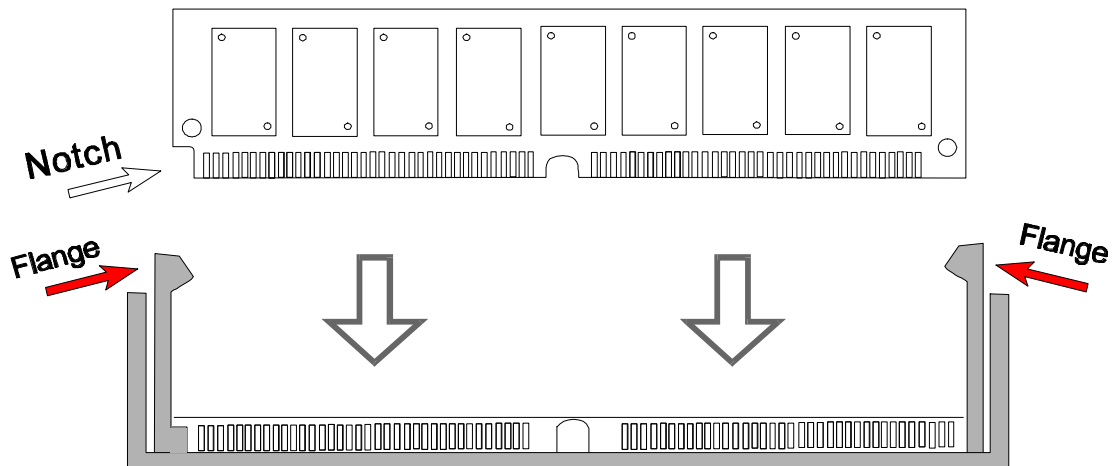
The SIMMs are available in 1MB (KTM1000/M70), 2MB (KTM2000/M70), and 4MB (KTM4000/M70) memory capacities. Be sure to observe the precautions below when installing the SIMMs. The SIMM modules are installed in descending order starting with the higher capacity SIMMs first. The first socket is P1, then P2, and so on.

The following chart illustrates various SIMM combinations and their corresponding socket locations for the KTM-609/16 Type I board which consists of four SIMM sockets (yours may have soldered memory with less sockets).

Total Memory on Board (MB)	SIMM Socket Locations			
	P1	P2	P3	P4
16	4	4	4	4
15 N/A				
14	4	4	4	2
13	4	4	4	1
12	4	4	4	-
11	4	4	2	1
10	4	4	2	-
9	4	4	1	-
8	4	4	-	-
7	4	2	1	-
6	4	2	-	-
5	4	1	-	-
4 (KTM-609/16-4)	4	-	-	-
3	2	1	-	-
2 (KTM-609/16-2)	2	-	-	-
1	1	-	-	-

**NOTE:** This chart does not represent all possible configurations.

1. Install the highest capacity SIMM in socket P1 on your KTM-609/16 board. Note that the SIMM plugs into the socket at an angle.
2. Carefully push the SIMM into the socket until it is firmly seated. Then push the SIMM gently toward the memory board until the flanges shown in Figure 4 snap over either end of the module.



**Figure 4 Installing the SIMM Modules**

3. If you have another SIMM to install, plug the next highest capacity SIMM in socket P2 on the KTM-609/16 board. Use the same technique you used to install the first.
4. If you have a third SIMM to install, plug the next highest capacity SIMM in socket P3 on the KTM-609/16 board.
5. And if you have a fourth SIMM to install, plug it into socket P4 on the KTM-609/16 board. It should be the lowest capacity SIMM of all.

Now you are ready to install the KTM-609/16 board into your PS/2 computer. Continue with the installation.



## Installing the KTM-609/16 Board

Now you're ready to install the KTM-609/16 Memory Expansion Board inside your PS/2 computer. Keep in mind the precautions on static electricity and magnetized tools. Turn off power to the computer and position it in a convenient, well-lit area. If this involves moving it very far from its normal location, you will need to unplug its various terminal and printer cables. Be sure to label them so you can easily reinstall them when you're done.

### STEP 1

- Turn power off from the computer.
- Disconnect any cables from the unit.

### STEP 2

- Open the chassis.
- Choose any available 16-bit expansion slot.
- Remove the expansion slot bracket.

### STEP 3

- Place the KTM-609/16 into the 16-bit expansion slot.
- Make sure the board is inserted into the guide channels and properly seated into the expansion slot.
- Secure the adapter card to the expansion slot with the thumb screw.

### STEP 4

- Replace the cover and reattach any cables that were disconnected.

The hardware portion of the installation procedure is now complete. You may want to leave the cover off during the remainder of the installation process in case it becomes necessary to move the KTM-609/16 for troubleshooting purposes. Now you're ready for "*Configuring the System*".

## Configuring the System

At this point, the KTM-609/16 is installed and needs to be configured before it can be recognized by the system. First you need to decide how to configure the newly added memory. For today's latest software, you will probably want to configure the memory as Extended, but if you are running older software applications which require EMS memory, then configure all or part of the Kingston memory as Expanded.

Here are a few guidelines:

- If your PS/2 runs software under Windows or OS/2, you should allocate all the new Kingston memory as **Extended** (XMS) memory, since Windows and OS/2 can address all added memory directly, and do not require an Expanded memory driver.
- If your PS/2 runs older software applications, such as Lotus 123 Ver. 2.x, or WordPerft 5.x for DOS, you should allocate the new Kingston memory as **Expanded** (EMS) memory. This entails using an EMS driver. Kingston provides the KTCEMM.SYS Expanded memory manager for 286 PS/2 computers.
- If your processor has been upgraded to a 386SX or higher processor, configure the Kingston memory as **Extended** and use EMM386.EXE with a RAM switch. This driver is found in your DOS or WINDOWS directory. Refer to your DOS manual for information on how to use this driver.

See Appendix A, "Extended vs. Expanded Memory" to help you decide the differences between the two types of memory allocation.

You may decide to change the allocations at any time, so keep your updated backup Reference diskette handy for future use. You'll also want to use this diskette whenever you need to see a display of the system configuration. Follow the steps below to configure the additional memory in your PS/2 computer.

1. Insert your backup Reference diskette (onto which you've already copied the files from the Kingston Option diskette) into the floppy drive.

2. Turn on or reboot your computer.
3. The system will boot up automatically from the backup Reference diskette. As the computer begins to boot, you should see the size of base memory displayed on your screen.
4. Next the number 165 appears on your screen to let you know the system has detected a device which hasn't been defined yet. After five or ten seconds, the IBM logo appears. Press [Enter] as prompted.
5. After a lengthy explanation of error 165, the system will prompt you: "Do you want to automatically configure the system? (Y/N)?" Press [N] for No. Running automatic configuration may set some of the adapters back to their default hardware settings. Just say NO to automatic configuration.
6. From the main menu, select *Set Configuration*.
7. Then select *Change Configuration*.
8. On the *Change Configuration* screen, move the cursor to the number of the slot in which you installed the KTM-609/16 board, and you will see:

```
Slot x - Kingston KTM-609/16 Memory Expansion Adapter
Expanded Memory ----- [Disabled]
```

Use the [F5] and [F6] Functions keys to specify the amount of memory you want to allocate as **Expanded** (paged) memory. The remaining memory, if any, is automatically allocated as **Extended**.

**NOTE:** You can only specify Expanded memory in increments of 1MB. **If you want all the added memory to be Extended, leave Expanded memory set to "Disabled".**

9. Press [F10] followed by an [Enter] to save the configuration.
10. Press the exit key twice ([ESC] or [F3] depending on version) to exit. To restart the system, press [Enter].
11. Now as the system boots, you will see the total amount of base and **Extended** memory displayed on the terminal screen. If the amount of **Expanded** memory was set to **disabled**, you will see all the Kingston memory

**Note:** Because **Expanded** (paged) memory requires an EMS driver to manage the paging, the amount of memory you allocated as Expanded will not appear until you load the Kingston EMS driver program in the next section.

If your PS/2 uses the OS/2 operating system, or if you allocated all the new memory as **Extended** in this section, YOU ARE FINISHED. You can use your PS/2 as usual, with the added power and memory of the Kingston Memory Expansion.

If you allocated some or all of the new memory as **Expanded**, turn to the next section, *"Installing the Kingston EMS Driver"*, to configure your system to use Expanded memory.

## Installing the Kingston EMS Driver

You only need to perform the instructions in this section if you allocated some or all of the new memory as **Expanded**.

The Kingston EMS driver you are about to install is the program that manages the paging of 16KB segments of memory into and out of the 64KB page frame located in reserved high memory.

1. Make sure your PS/2 is booted from your standard DOS diskette in drive A, or from the hard disk, drive C. Remove the boot diskette from drive A, if necessary, and insert the Kingston Option Diskette into drive A. At the DOS prompt, type:

**A:**

and press [Enter].

2. To start the INSTALL program, type:

**INSTALL**

Now when you press [Enter], the following screen appears:

```
INSTALLATION Version 1.0
(C) Copyright 1990, Kingston Technology Corporation

F1 Install Configuration Files onto Reference Disk
F2 Install KEMM.SYS EMS Driver onto a Working Disk.
F3 Change Existing EMS Driver Parameters.
F4 Exit and Back to DOS
```

3. Press [F2] (Function Key F2) to copy the EMS driver from the Kingston Option Diskette onto the boot disk.
4. When the next screen appears, press [F1] if your computer boots from a floppy diskette in drive A, or press [F2] if your computer boots from the internal hard disk, drive C. Then press [Enter] to continue.

INSTALLATION Version 1.0 (C) Copyright 1990, Kingston Technology Corporation
Install EMS Driver onto a New Drive and Configure  F1 Drive A: if system is booted up from floppy diskette F2 Drive C: if system is booted up from hard disk

5. Next, the INSTALL program asks for the pathname of the subdirectory where you want to store the EMS driver. For example, to store the EMS driver under ABC on your hard disk, type:

**C:\ABC [Enter]**

Press any key to continue.

INSTALLATION Version 1.0 (C) Copyright 1990, Kingston Technology Corporation
Install EMS Driver onto a New Drive and Configure  F1 Drive A: if system is booted up from floppy diskette F2 Drive C: if system is booted up from hard disk
Path [C:\ABC            ]

6. If your computer boots from a floppy diskette, remove the Kingston Option Diskette from drive A, and insert your standard DOS boot diskette. Press any key to continue.

INSTALLATION Version 1.0 (C) Copyright 1990, Kingston Technology Corporation
Install EMS Driver onto a New Drive and Configure
Insert Kingston Option Diskette into Drive A: Press Any Key to Continue

The INSTALL program now copies the EMS driver from the computer's memory onto the disk you specified as your boot device.

7. The next screen asks you to select the memory segment of Reserved High Memory where you want to place the paging area. We recommend that you choose the default selection, D000, by pressing [F4].

**Note:** The memory segment map requires 64KB of contiguous memory starting at location D000 (DEFAULT). This means that segments D000-DFFF cannot be occupied by any other adapters. Therefore, if any other adapters occupy any portion of this space, they must be relocated via the IBM Setup Program.

The KTM-609/16 memory segment map can also be relocated as described below.



```

INSTALLATION Version 1.0
(C) Copyright 1990, Kingston Technology Corporation

Install EMS Driver onto a New Drive and Configure

F1 A000 Only if MONOCHROME CARD is installed in your system
F2 B000 Reserved
F3 C000 Reserved
F4 D000 Default Selection

```

8. Two additional choices now appear on your screen.

```

INSTALLATION Version 1.0
(C) Copyright 1990, Kingston Technology Corporation

Install EMS Driver onto a New Drive and Configure

F1 A000 Only if MONOCHROME CARD is installed in your system
F2 B000 Reserved
F3 C000 Reserved
F4 D000 Default Selection

F1 YES if you would like to update the config.sys file
F2 NO if you do not want to update the config.sys file

```

- If you want to proceed, press [F1] to update the CONFIG.SYS file.
- If you think you missed a step and need to do this procedure over again, press [F2] to bypass updating the CONFIG.SYS file.

9. Press any key to return to the Installation Menu screen, then press [F4] to return to the DOS prompt.
10. Now reboot the computer as usual. As the computer reboots, you will see displayed on the screen the total amount of memory minus any that you allocated as Expanded memory. When the EMS driver initializes, it will display the amount of Expanded memory.

Now that the Kingston EMS driver is properly installed, you are ready to begin using your PS/2 computer system to run programs and applications with the additional memory capacity of the Kingston KTM-609/16 Memory Expansion Board.

## Changing Existing EMS Driver Parameters

Any time you want to change the location of the paging area in reserved high memory, you can rerun the INSTALL program.

1. Make sure your PS/2 is booted from your standard DOS diskette in drive A, or from the hard disk, drive C. Remove the boot diskette from drive A, if necessary, and insert the Kingston Option Diskette into drive A, and at the DOS prompt, type:

**A:**

and press [Enter].

2. To start the INSTALL program, type:

**INSTALL**

Now when you press [Enter], the following screen appears:

```
INSTALLATION Version 1.0
(C) Copyright 1990, Kingston Technology Corporation

F1 Install Configuration Files onto Reference Disk
F2 Install KEMM.SYS EMS Driver onto a Working Disk.
F3 Change Existing EMS Driver Parameters.
F4 Exit and Back to DOS
```

3. Press [F3] (Function Key F3) to change the existing EMS driver parameters.
4. The next screen asks you to select the memory segment of Reserved High Memory where you want to place the paging area. Press the function key that corresponds to the starting address where you want the paging area to be located.

```
INSTALLATION Version 1.0
(C) Copyright 1990, Kingston Technology Corporation

Install EMS Driver onto a New Drive and Configure

F1 A000 Only if MONOCHROME CARD is installed in your system
F2 B000 Reserved
F3 C000 Reserved
F4 D000 Default Selection
```

5. Two additional choices now appear on your screen. Refer to the next page.

```
INSTALLATION Version 1.0
(C) Copyright 1990, Kingston Technology Corporation

Install EMS Driver onto a New Drive and Configure

F1 A000 Only if MONOCHROME CARD is installed in your system
F2 B000 Reserved
F3 C000 Reserved
F4 D000 Default Selection

F1 YES if you would like to update the config.sys file
F2 NO if you do not want to update the config.sys file
```

- If you want to proceed, press [F1] to update the CONFIG.SYS file.
  - If you think you missed a step and need to do this procedure over again, press [F2] to bypass updating the CONFIG.SYS file.
6. Press any key to return to the Installation Menu screen, then press [F4] to return to the DOS prompt.
  7. Now reboot the computer as usual. If the paging area has been successfully relocated, there will be no visible indication. Your system should operate as usual.

## Changing the System Configuration

Normally, you should never have to change memory allocation on your PS/2, but if a situation does arise (such as the addition or removal of hardware devices or software applications), you may wish to redistribute the amount of memory you have allocated as either **Extended** (linear) or **Expanded** (paged).

Remember, if your PS/2 runs under Windows or OS/2, all system memory should be allocated as **Extended** memory, since Windows and OS/2 can address all added memory directly.

If your PS/2 runs under DOS, you can allocate the new Kingston memory as either **Extended** or **Expanded** or any combination of the two. You may want to review "*Appendix A Extended vs. Expanded Memory*," which discusses the differences between the two types of memory allocation.

### Adding or Removing SIMMs

1. Insert your backup copy Reference diskette (onto which you have already copied the Kingston option files) in drive A.
2. Reboot the computer. The number 164 appears on your screen during boot-up. (The number 164 indicates a memory size mismatch in the system.) After 5 to 10 seconds, the IBM logo appears.
3. Press [Enter] to see the next screen.
4. Press [N] for No to automatically configure the system.
5. When the *Set Configuration* menu appears, select *Change Configuration*, and press [Enter].

6. On the *Change Configuration* screen, move the cursor to the number of the slot where the KTM-609/16 board is located, and use the [F5] and [F6] functions keys to specify the amount of memory you want to allocate as **Expanded** (paged) memory. The remaining memory, if any, is automatically allocated as **Extended**.
7. Press [F10] followed by an [Enter] to save the configuration.
8. Press the exit key ([ESC] or [F3] depending on version) to exit from the *Set Configuration* Screen.
9. Press the exit key again to return to your system prompt.
10. Remove the backup Reference diskette from drive A.
11. You are now ready to reboot with the newly configured memory.
12. As the system boots, you will see the total amount of memory minus the amount allocated as Expanded displayed on the screen. When the EMS driver initializes, it will display the amount of memory allocated as **Expanded** memory.

## Changing the Amount of Expanded Memory

1. Insert the backup Reference diskette into drive A.
2. Reboot the computer.

**NOTE:** No error occurs during boot-up, and therefore, auto-configure is not asked for.

3. When the *Set Configuration* menu appears, select *Change Configuration*, and press [Enter].

4. On the *Change Configuration* screen, move the cursor to the number of the slot where the KTM-609/16 board is located, and use the [F5] and [F6] functions keys to specify the amount of memory you want to allocate as **Expanded** (paged) memory. The remaining memory, if any, is automatically allocated as Extended.
5. Press [F10] followed by an [Enter] to save the configuration information in CMOS memory.
6. Press the exit key ([ESC] or [F3] depending on version) to exit from the *Set Configuration* screen.
7. Press the exit key again to return to your system prompt.
8. Remove the backup Reference diskette from drive A.
9. You are ready to reboot with the newly configured memory.
10. Now as the system boots, you will see the total amount of memory minus the amount allocated as Expanded displayed on the screen. When the EMS driver initializes, it will display the amount of memory allocated as Expanded memory.

# Appendices



## Appendix A Extended vs. Expanded Memory

There are two ways you can define the newly added memory in your PS/2 computer system. You can define it as Extended memory or Expanded memory, or as a combination of the two. To understand the difference between the two ways you can configure memory, we need to take a step back in time.

### Some History

When the PC was first designed, everyone thought that 640KB would be more memory than anyone could possibly use for their programs and data. The IBM PC originally contained an 8088 microprocessor which could address 1MB of memory, and the DOS operating system was designed to recognize only that much memory. Of the 1MB available, 640KB was devoted to running application programs. This portion of memory is also referred to as **conventional** or **base** memory.

The remaining 384KB of addressable memory, between 640KB and 1MB, is referred to as **reserved high memory**. This area of memory was devoted to video RAM, ROM BIOS (the Read Only Memory Basic Input/Output System), and other system and peripheral functions.

The next stage in the evolution of the PC was the PC AT which contains an 80286 microprocessor capable of addressing 16MB of memory. Current IBM PS/2 Model 50 and Model 60 computers also use this processor. However, DOS retained its 1MB addressing limitations so it would still be compatible with the older systems.

### Extended (Linear) Memory

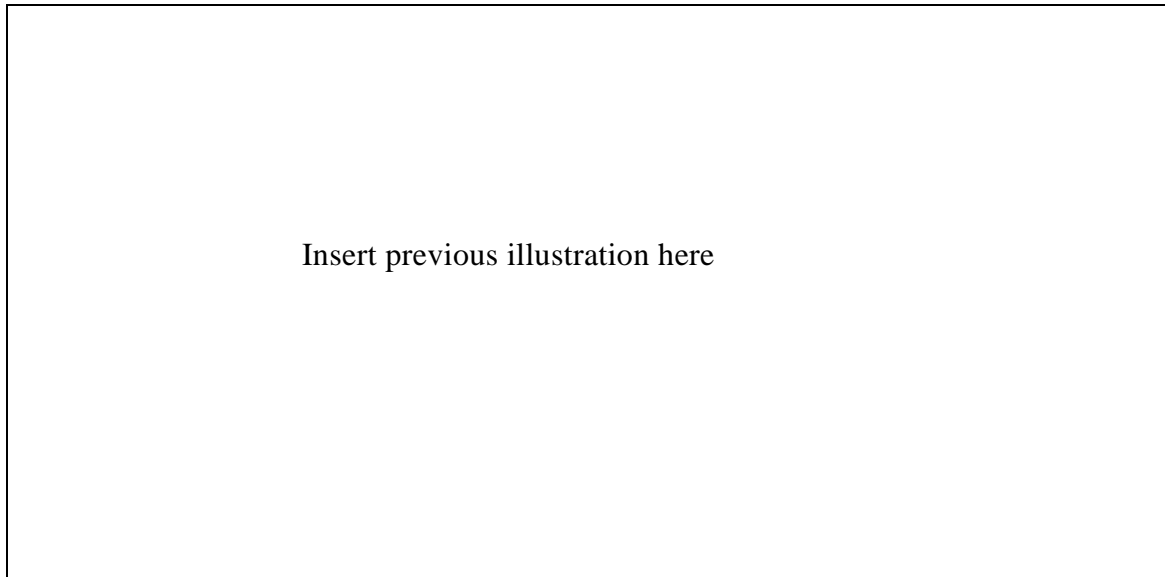
The original 640K of memory was still available for use by DOS-compatible application programs, while the memory above 1MB (the Extended memory) could be used by the processor for print spoolers and RAM disks.

Because the memory addresses continue sequentially from beginning to end, this memory is known as linear memory. Both conventional and Extended memory are classified as linear memory.

## Expanded (Paged) Memory

The development of the Expanded Memory System (EMS) was a software solution to the memory limitations of DOS. EMS uses a 64KB area of reserved high memory (the area between 640KB and 1MB that DOS is able to get to), and copies four 16KB “pages” of data back and forth as needed from the higher areas of memory that DOS cannot get to. The EMS acts as a messenger to locate and retrieve the segments of memory DOS requests and place them within its reach.

EMS software allows you to allocate up to 32MB of memory as Expanded memory since it is not restricted by the 1MB limit of DOS or the 16MB limit of the processor.



*Figure A-1 Extended and Expanded Memory Configuration*

## Appendix B Modifying CONFIG.SYS

Caution: In very rare and special situations, the configuration of your PS/2 computer system may require that you modify the CONFIG.SYS file directly. Please do not attempt to update this file unless you are familiar with using a text editor such as DOS's EDIT (newer version) or EDLIN (older version).

### Installing the Driver

Before attempting to install the device driver, make sure that the computer has expansion memory installed, and that the additional memory is allocated as **Expanded** memory. In addition, verify the following:

- Total amount of system memory (check when booting the system).
- That the system is not currently using any other EMS drivers. (You must remove these device drivers before attempting to install the Kingston EMM driver.)
- That a standard installation and setup procedure has been carried out before installing the Kingston EMS driver (See "Installing the Kingston EMS Driver).
- The Kingston EMS driver must be loaded as part of the boot sequence when the computer is turned on or restarted. Installation of the device driver is accomplished by placing a command in the computer's CONFIG.SYS file, which is the file the computer's operating system reads when the system is turned on or restarted. The CONFIG.SYS file must be in the root directory of the diskette or hard disk drive from which the computer boots.

Use your favorite text editor to modify CONFIG.SYS. The CONFIG.SYS file should contain the following command line:

```
DEVICE=d:[path]\KTCEMM.SYS[options]
```

where d: and [path] represent the drive and path where the driver is located, and [options] represents those parameters described in the "*Command Line Options*"

section later in this appendix. If you leave the options out of the command line, default values are used.

## Testing the Kingston EMS Driver

Restart the computer to activate the Kingston EMS driver. When the driver is active, the following message appears:

```
Kingston Expanded Memory Manager Version 1.x  
  
Kingston EMS Add-in Board Installed  
1 Alternate Register Set(s) Found  
256 EMS Pages Found (4096KB)  
Total Memory Available for EMM Use = 4096KB
```

If an error message appears, refer to Appendix C, "*Troubleshooting*."

## Command Line Options

Optional command line parameters are provided for customizing the Kingston EMS driver for different environments. Options must be separated by one or more spaces. Spaces are optional before and after the '-' and '=' symbols. The options are as follows:

### **HANDLES = hhh**

Specifies the number of handles and names available. Handles are the values the memory manager assigns to identify a block of memory requested by an application program. Each application that uses Extended or Expanded memory requires at least one handle. Some need more than one, and they let you know if they run out of handles. The parameter hhh must be in the range 16 to 255. Note that each handle/name increases the amount of memory required and decreases the amount available to the application program. The default (64) should be adequate for most purposes.

### **EXCLUDE = xxxx [-cccc]**

Specifies an area of memory that should not be under the control of the driver. The parameters xxxx and cccc specify the range of memory to be excluded. The xxxx parameter should be a multiple of 16KB (that is, end in 00). For example if a network card had memory at address CC00, then EXCLUDE = CC00-CFFF should be used. Note that the driver checks for the presence of ROM/RAM in the range A000-FFFF,

so there is not usually any need to use EXCLUDE. The area F000-FFFF is always occupied by system ROM.

**INCLUDE = xxxx [-cccc]**

Specifies the memory to be included under the control of the driver. Parameters are similar to the EXCLUDE option above. For example, if an EGA video adapter is installed in the computer, the monochrome graphics section of memory might not be used. So INCLUDE B000-B7FF would allow the driver to make use of this area of memory.

**Note:** If you are editing the command line yourself, the EXCLUDE and INCLUDE options may be used several times to exclude or include several areas of memory, though at least 64KB of memory above 640KB (A000) should remain. The facility is not available using the setup program. If you specify the same area of memory in an EXCLUDE and an INCLUDE statement, the command line order determines which statement will take effect.

**FRAME = aaaa**

Specifies the page frame starting address (i.e., a contiguous 64KB segment through which the Expanded memory is mapped). The parameter **aaaa** must be one of the following values: C000, C400, C800, CC00, D000, D400, D800, DC00, or E000. Specifying FRAME overrides the automatic choice of page frame. If you need to specify a frame address, try **D000**, which uses the range D000-DFFF. The D range is usually available.

**IOADDR = aaaa**

Overrides the default base I/O address at which the EMS hardware should be configured. The parameter **aaaa** must be one of the following values: 0208, 0218, 0258, 0268, 02A8, 02B8, or 02E8. The default is 0208 (hex). You should not change this unless you are sure that you have a conflict with another card.

**SCAVENGE = xxxx [-cccc]**

Specifies an area of system shadow RAM in the range A000-FFFF to be used for EMS memory. Normally, the shadow RAM is used to overlay system ROM regions, for the purpose of speeding up code execution from those areas. Not all of the shadow RAM is used, however. The areas that are not used may be scavenged for use as EMS

memory with the SCAVENGE option. In most cases, SCAVENGE = A000-FFFF is sufficient; however, some systems may experience problems. In cases where problems are encountered, specific areas such as video adapters may have to be avoided (SCAVENGE = C800-FFFF).

## Appendix C Troubleshooting

Once installed, Kingston Memory Expansion Boards are virtually trouble-free. You never need to give them a second thought. However, during the installation and configuration process, you may encounter situations that will test your diagnostic skills as well as your patience.

### Error Messages

This section contains explanations of messages that may appear as a result of changes you made while using the INSTALL program, or as the result of changes you made directly to your CONFIG.SYS file. As a general rule, you should reboot the computer with the backup Reference diskette, fix the problem, and then reboot the computer from its standard diskette or hard drive.

In the event you see one of the hardware-related messages, you need to review the procedure you used to install the memory modules on the circuit board and the procedure you used to install the circuit board into the computer chassis.

#### **An equal sign (=) was expected.**

This message indicates you left out a required equal sign from one of the command options in the CONFIG.SYS file. Review the changes you made to CONFIG.SYS and correct the error.

#### **Cannot detect mapping hardware.**

This message indicates a possible hardware problem or conflict with another adapter. Review the steps you took to install the SIMMs on the KTM-609/16 board, and the steps you took to install the memory board in the computer. Make sure the SIMMs are installed in the correct sequence on the memory board, and that all the SIMMs on the memory board are seated firmly in their sockets. If the error persists, try changing the I/O Address of the offending adapter. The KTM-609/16 uses an I/O address of 0208h. Other adapters like the IRMAboard® use an address range of 0200h-0220h. Change the IRMAboard I/O address to avoid conflicts.



**The command line is incomplete.**

You modified the CONFIG.SYS file, but something is missing from one of the command options. Check each option you added or changed, and make sure each has the appropriate argument.

**Decimal number overflow error.**

Only the HANDLES option accepts a decimal argument; the other options require hexadecimal arguments. Check the CONFIG.SYS file to make sure you have specified arguments for each option in the appropriate notation.

**FATAL ERROR - Memory manager not installed.**

You have specified all or part of the new memory to be used as Expanded (paged) memory, but you have not installed the Kingston EMS driver either with the INSTALL program or by modifying the CONFIG.SYS file directly. Reboot your computer using the backup Reference diskette, and use either the INSTALL program, or modify the CONFIG.SYS file (see Appendix B). When the appropriate driver for your Expanded memory is in place, you can reboot from your standard DOS diskette or hard drive.

**Faulty or missing memory detected.**

This message indicates a possible hardware problem. Review the steps you took to install the SIMMs on the Kingston Memory Expansion Board, and the steps you took to install the memory board in the computer. Make sure the SIMMs are installed in the correct sequence on the memory board, and that all the SIMMs and memory boards are seated firmly in their sockets. Reboot from your standard DOS diskette or hard drive.

**Hardware does not support EMS version 4.**

This message indicates a possible hardware problem. Review the steps you took to install the SIMMs on the Kingston Memory Expansion Board (see *"Installing the SIMMs"*), and the steps you took to install the memory board in the computer (see *"Installing the KTM-609/16"*). Make sure the SIMMs are installed in the correct sequence on the memory board, and that all the SIMMs and memory boards are seated firmly in their sockets. Reboot from your standard DOS diskette or hard drive.

**Interrupt 67 vector already allocated.**

You modified the CONFIG.SYS file to include the Kingston EMS driver. Now, the Kingston EMS driver is trying to use an interrupt vector already being used by some other driver. Check the CONFIG.SYS file to make sure no other EMS drivers are being used. If you find another driver in CONFIG.SYS, remove it, and reboot from your standard DOS diskette or hard drive.

**Invalid hex number or number not divisible by 16.**

The EXCLUDE, INCLUDE, and FRAME options in CONFIG.SYS require hexadecimal arguments. Reboot your computer with the backup Reference diskette, and check CONFIG.SYS to make sure these options, if present, have hexadecimal arguments. The allowable values are described in Appendix B, "Modifying CONFIG.SYS." You may also see this message if the end address is less than the start address in an EXCLUDE or INCLUDE option.

**Invalid page frame address.**

The page frame address in the FRAME option in the CONFIG.SYS file must be one of the following values:

C000, C400, C800, CC00, D000, D400, D800, DC00, or E000

Check your CONFIG.SYS file and make sure it contains a valid FRAME address. (We recommend that you do not use the FRAME option. Delete the FRAME option, and let the Kingston EMS driver automatically set the page frame address for you.)

**I/O address specified is not one of the permitted values.**

The I/O address in the IOADDR option of your CONFIG.SYS file must be one of the following values:

0208, 0218, 0258, 0268, 02A8, 02B8, or 02E8

If you omit the IOADDR option, the Kingston EMS driver uses the default address value of 0208. You only need to specify this option if you are sure there is an address conflict with another circuit board.

**No working memory can be found. EMM aborted.  
Initialization Error. Memory Manager NOT Installed.**

This message indicates that no Expanded memory is available. The likely cause is that none has been allocated or the EMS driver did not load correctly. Also, the EMS driver (KTCEMM.SYS) needs 64K of contiguous space in upper memory to load correctly. Trying specifying a frame address of D000 to load the driver. Your driver statement in CONFIG.SYS should look like this:

```
DEVICE=C:\KTCEMM.SYS FRAME=D000
```

**Number of handles is invalid or out of range.**

The number of handles specified in your CONFIG.SYS file must be a decimal number in the range 16 to 255. (If you did not specify the HANDLES option, the default value is 64.) Reboot your computer with the backup Reference diskette, and check the CONFIG.SYS to make sure you specified a valid number of handles.

### **Unrecognized option/command in invocation line.**

There is a typographical error in one of the options you added or changed in the CONFIG.SYS file. Check the option formats in Appendix B, "Modifying CONFIG.SYS" to make sure your CONFIG.SYS file is correct.

### **WARNING: Problems encountered in setting default page frame address.**

This message indicates a possible hardware problem. Review the steps you took to install the SIMMs on the Kingston Memory Expansion Board (See "*Installing the SIMM Modules*"), and the steps you took to install the memory board in the computer (See "*Installing the KTM-609/16 Board*"). Make sure the SIMMs are installed in the correct sequence on the memory board, and that all the SIMMs and memory boards are seated firmly in their sockets. Reboot from your standard DOS diskette or hard drive.

### **Working With QEMM 50/60 Memory Manager**

In order to use the Quarterdeck QEMM 50/60 Expanded Memory Manager, you must have QEMM version 6.0 with KTM-609/16 Plus revision C or later.

**Note:** When using QEMM 50/60, you must configure the KTM-609/16 memory as **Extended** memory. Refer to "*Configuring the System*" section of this manual for details.

## Revision History

<b>Revision Level</b>	<b>Comment</b>
D1	Added Type II and Type III board layouts as follows: Type I - 0MB soldered 4 SIMM sockets Type II - 4MB soldered 3 SIMM sockets Type III - 8MB soldered 2 SIMM sockets  Re-wrote INSTALL procedure, Extended v. Expanded Memory, Troubleshooting Error Messages.