SCSI Hard Disk Drives For IBM PCs

User's Guide

OPTIONS
by IBM

Note: Before using this information and the product it supports, be sure to read the *SCSI Hard Disk Drive User's Guide Supplement* for warranty information and jumper setting information for your drive. Also, refer to "Notices" on page 2-5 for notices and trademark information.

Second Edition (June 2000)

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Safety: Read first

Before installing this product, read the Safety Information.

Antes de instalar este produto, leia as Informações de Segurança.

在安装本产品之前，请仔细阅读 Safety Information (安全信息)。

Prije instalacije ovog produkta obavezno pročitajte Sigurnosne Upute.

Před instalací tohoto produktu si přečtěte příručku bezpečnostních instrukcí.

Læs sikkerhedsforskrifterne, før du installerer dette produkt.

Ennen kuin asennat tämän tuotteen, lue turvaohjeet kohdasta Safety Information.

Avant d'installer ce produit, lisez les consignes de sécurité.

Vor der Installation dieses Produkts die Sicherheitshinweise lesen.

Πριν εγκαταστήσετε το προϊόν αυτό, διαβάστε τις πληροφορίες ασφάλειας (safety information).

A termék telepítése előtt olvassa el a Biztonsági előírásokat!

Prima di installare questo prodotto, leggere le Informazioni sulla Sicurezza

製品の設置の前に、安全情報をお読みください。

본 제품을 설치하기 전에 안전 정보를 읽으십시오.

Пред да се инсталира овој продукт, прочитајте информацијата за безбедност.

Lees voordat u dit product installeert eerst de veiligheidsvoorschriften.

Les sikkerhetsinformasjonen (Safety Information) før du installerer dette produktet.

Przed zainstalowaniem tego produktu, należy zapoznać się z książką "Informacje dotyczące bezpieczeństwa" (Safety Information).

Antes de instalar este produto, leia as Informações sobre Segurança.

Перед установкой продукта прочтите инструкции по технике безопасности.

Pred inštaláciou tohto zariadenia si pečítaje Bezpečnostné predpisy.

Pred namestitvijo tega proizvoda preberite Varnostne informacije.

Antes de instalar este producto lea la información de seguridad.

Läs säkerhetsinformationen innan du installerar den här produkten.

安裝本產品之前，請先閱讀「安全資訊」。

Registering your option

Thank you for purchasing OPTIONS by IBM®. Please take a few moments to register your product and provide us with information that will help IBM to better serve you in the future. Your feedback is valuable to us in developing products and services that are important to you, as well as in developing better ways to communicate with you. Register your option on the IBM Web site at:

http://www.ibm.com/pc/register

IBM will send you information and updates on your registered product unless you indicate on the Web site questionnaire that you do not want to receive further information.

About this book

This manual contains information on the IBM Ultra2 and Ultra160 SCSI Hard Disk Drives. It is divided into the following parts:

Part 1: Quick installation instructions in the following languages:

- English
- German
- French
- Italian
- Spanish
- Brazilian Portuguese
- Japanese

Part 2: Performance data, problem solving, help and service, notices, trademark, and electronic emmissions information

Note: The illustrations in this manual might be slightly different from your hardware.

Part 1: Installation and user's guide

This section contains the product description, installation instructions, and information on how to use the product.

Product description

Your IBM® SCSI hard disk drive is a new Ultra2 or Ultra160 SCSI device that uses low-voltage differential (LVD) signal transmission that can accelerate data transfer speed and lengthen a SCSI device chain. Ultra2 SCSI devices, working only with other Ultra2/Ultra160 SCSI devices on a SCSI device chain, support a maximum instantaneous data transfer rate of 80 MBps (Megabytes per second). Ultra160 SCSI devices, working only with other Ultra2 or Ultra160 devices on a SCSI device chain, support a maximum instantaneous data transfer rate of 160 MBps. You can also connect up to 16 Ultra2 or Ultra160 SCSI devices together on a SCSI device cable that can be as long as 12 m (39 ft). Ultra2 and Ultra160 SCSI drives also have single-ended transceivers which allow the drives to work with single-ended SCSI devices. However, when an Ultra2 or Ultra160 SCSI drive is connected with single-ended devices on a SCSI device chain, the maximum data transfer rate is reduced to 40 MBps, and the maximum SCSI cable length for the device chain is reduced to 3 m (10 ft) when less than four devices are on the chain or 1.5 m (5 ft) when four or more devices are on the chain.

Your Ultra2 or Ultra160 SCSI drive meets the Small Computer System Interface (SCSI) standard set by the American National Standards Institute (ANSI), and can be installed only in a computer that uses the SCSI architecture.

You can configure your new SCSI hard disk drive in any of the following ways:

- Single-drive configuration
  - To add a hard disk drive to a computer
  - To replace an installed hard disk drive
- Multiple-drive configuration
  - To operate with installed IDE hard disk drives
  - To operate with installed SCSI hard disk drives

In addition to this book, this option package contains:

- SCSI hard disk drive
- Option jumpers
- Mounting screws
- *SCSI Hard Disk Drive User's Guide Supplement*
- Safety information manual

Contact your place of purchase if any parts are missing or damaged. Be sure to retain your proof of purchase; it might be required to receive warranty service.

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Preparing for installation

This section contains information on how to prepare for installation. To install the SCSI hard disk drive you need the following:

Documentation
The documentation that comes with your computer, SCSI adapter, and operating system.

SCSI adapter and SCSI cable
Your computer must have a SCSI adapter and a SCSI cable with an available interface connector. If you are not sure about your computer interface type, see the documentation that comes with your computer.

Drive mounting location
The hard disk drive you are installing is designed for a 3.5-inch bay, but it can be adapted to fit into a 5.25-inch bay.

To mount the hard disk drive in a 5.25-inch bay, you will need to attach 3.5-inch-to-5.25-inch conversion hardware (not included). You can purchase a conversion kit (IBM part number 70G8165) from your IBM reseller. You might need flat-blade and Phillips-head screwdrivers to install the drive.

Some installations also require mounting rails or other special hardware in addition to the conversion hardware.

Software
One of the following operating systems:

- Microsoft® Windows® 2000 Professional or Windows 2000 Server
- Windows NT® Workstation
- Windows 98
- Windows 95 OSR2
- Windows 3.x
- IBM OS/2®
- DOS 5.0 or later

Backing up files

If you are replacing an installed hard disk drive, make a backup copy of the data from the drive that you are replacing.

You can use the XCOPY program to copy groups of files, including directories and subdirectories, from one drive to another. If the destination already contains a file or directory with the same name, XCOPY prompts you for a decision about overwriting the file. If you need more information about XCOPY or backing up your hard disk drive, see “Copying files to your new primary drive” on page 1-16, or the documentation that comes with your operating system.

Creating a system diskette

If your computer will not restart, you might be able to recover by using a System Diskette. The System Diskette allows you to recover if you cannot restart (boot) your computer from a previously installed hard disk drive, and you do not have a backup diskette. When you restart your computer, the Basic Input/Output System (BIOS) checks the diskette drive for a System Diskette before it checks the primary partition on the hard disk drive.

The System Diskette contains the minimum set of files needed to start your computer. In addition to the minimum set of files, you might want to copy other useful files, such as FDISK, FORMAT, XCOPY, CHKDSK, and MEM, to the System Diskette.

To create a System Diskette for DOS:

1. Insert a blank diskette into drive A.
2. At the DOS prompt, type `format a: /s`. The `/s` parameter creates the System Diskette.
3. Follow the on-screen instructions.
4. When the format process completes, copy the FDISK.COM, FORMAT.COM, DISKCOPY.EXE, CHKDSK.COM, and MEM.EXE utility programs from the DOS directory to the diskette.

To create a System Diskette for Windows 98 or Windows 95:

1. Click **Start → Settings → Control Panel**.
2. From the Control Panel window, double-click **Add/Remove Programs**.
3. Click the **Startup Disk** tab.
4. Follow the instructions on your screen.

To create Utility (System) Diskettes for OS/2:

1. Double-click **OS/2 System** on your Desktop.
2. Double-click **System Setup**.
3. Double-click **Create Utility Diskettes**. The Create Utility Diskettes window opens.
4. Follow the instructions on your screen. OS/2 creates three Utility Diskettes.

You can also create the Utility Diskettes from the OS/2 CD-ROM by running CDINST.CMD from the file directory.

Installing the drive

These instructions are general guidelines for installing the IBM SCSI Hard Disk Drive in most computers. For specific information, see the documentation that comes with your computer.

Note: If you are installing the SCSI hard disk drive in a disk-array system, do not use these installation instructions. See the instructions that come with the disk-array system.

Step 1. Selecting a SCSI ID

Each SCSI device, including the SCSI adapter, must be assigned a SCSI identification number (ID). Use the following table as a guideline for selecting the best SCSI ID for your device:

SCSI device	Best SCSI ID
Tape drive	0
CD-ROM drive	1
High-density diskette drive	2
Removable hard drive	3
Third hard disk drive	4
Second hard disk drive	5
Startup hard disk drive	6
SCSI adapter	7
Additional hard disk drives	15 through 8 (decreasing order of priority)

For more information on setting SCSI IDs, use the following guidelines.

- You cannot assign the same ID to multiple devices on the same SCSI adapter.
- The ID you assign to your new drive depends on the number of SCSI devices connected to the SCSI adapter, the SCSI IDs already assigned to those devices, and the maximum number of IDs for your SCSI adapter.
- SCSI ID 7 is normally reserved for the SCSI adapter.
- Assign the higher priority SCSI IDs (the highest priority is normally 6) to devices, such as hard disk drives, that are faster and are used the most. Assign lower priority SCSI ID numbers to slower SCSI devices, such as CD-ROM drives and tape drives. SCSI ID priorities are assigned by the SCSI adapter.
- Narrow SCSI devices (devices with 50-pin connectors) such as high-density diskette drives, CD-ROM drives, smaller tape drives and removable hard drives can only connect to the wide SCSI device chain using a 50-to-68 pin connector, or through a separate 50-pin conductor cable. These narrow devices only use SCSI ID addresses from 0 to 6, and they must be assigned to the lowest priority SCSI ID's available in that range.
- Most IBM computer systems come with the SCSI adapter preset to look to SCSI ID 6 for the startup drive that contains your operating system.

- Before you install the drive, determine which SCSI IDs are already assigned to avoid assigning duplicate ID numbers.

Note: Most narrow 50-pin SCSI devices are pre-Ultra2 SCSI devices. When pre-Ultra2 SCSI devices are added to an Ultra160 or Ultra2 device chain, the maximum burst data rate for the Ultra160 or Ultra2 SCSI drives attached to that device chain will be reduced from 160 MBps (Ultra160) or 80 MBps (Ultra2) to 40 MBps.

If you have multiple high performance drives and data-rate sensitive software, you need to purchase a separate adapter for the pre-Ultra2 SCSI devices (such as the IBM PCI Fast/Wide Ultra SCSI Adapter, P/N 02K3454).

Step 2. Opening the computer

Turn off the computer and unplug the power cords for the computer and all attached devices. Open the computer. For specific information on opening your computer see the documentation that comes with your computer.

If you are replacing your primary hard disk drive, copy the files from that drive using the instructions given in “Copying files to your new primary drive” on page 1-16 before you disconnect it.

Step 3. Unpacking the drive

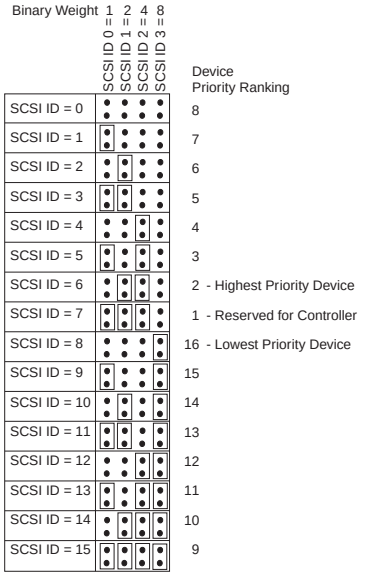
Use the following procedure to unpack and handle the drive. To prevent damage to the drive, limit handling to a minimum.

1. Before opening the static-protective bag containing the drive, touch the bag and your hand to an unpainted metal surface on the computer for at least two seconds.
2. Remove the drive from the static-protective bag and handle it by the edges. Do not touch any exposed components on the drive.
3. If you must put the drive down, place the static-protective bag on a flat padded surface, such as a magazine, and place the drive on the bag with the component side facing up.

Step 4. Setting the SCSI ID for the drive

Set the SCSI ID for your drive by placing jumpers on the appropriate drive jumper pins. See your *SCSI Hard Disk Drive User's Guide Supplement* and the diagram below for information on SCSI ID jumper placement.

Note: The alignment of the jumper pins on the diagram might be the reverse of the alignment of the jumper pins on your drive. Be sure to use the *SCSI Hard Disk Drive User's Guide Supplement* to confirm the correct jumper placement.



Save any spare jumpers; you might have to change the SCSI ID. Refer to the *SCSI Hard Disk Drive User's Guide Supplement* to determine if you can safely store spare jumpers on the drive jumper pins.

Step 5. Determining whether to disable Auto Start or Auto Spinup

Note: Be sure that Auto Start is disabled when you are installing the hard disk drive in an IBM server.

Refer to the *SCSI Hard Disk Drive User's Guide Supplement* to determine if Auto Start (also called Auto Spinup or Motor Start) is enabled on your drive jumper pins. If Auto Start is enabled, this attached drive starts at once when the computer is turned on. However, starting two or more drives simultaneously might overload the computer power supply. If you want to sequence drive startup to flatten the power peak required for drive startup, be sure that Auto Start is disabled. If Auto Start is disabled, the drive is prevented from starting until it receives the Start Unit command from the SCSI adapter. Most SCSI adapters send the Start Unit commands to the drives sequentially from SCSI ID 0 to SCSI ID 15.

If you are using an IBM computer, use the following instructions to verify that the SCSI adapter will send the Start Unit command to your drive.

1. Turn on your computer.
2. Press Ctrl+A during the SCSI Adapter Power-on self-test (POST) window.
3. Select **Configure/View Host Adapter Settings** and then press Enter.
4. Select **SCSI Device Configurations** and then press Enter.
5. Be sure that **yes** is selected for **Send Start Unit Command** under the SCSI ID assigned to your drive.
6. Press Esc twice to save changes.
7. Select **Yes** to exit Utilities.

For more information, refer to the specifications for your drive and power supply.

For more information about drive startup, see the documentation that comes with your SCSI adapter.

For SCSI adapters that do not send the Start Unit command, see the documentation that comes with your SCSI adapter.

Installing other jumpers

Spindle Sync, Parity Disable, Write Protect, Auto Start Delay, Disable Unit Attention, and other jumper positions that might be on the drive jumper block are not needed for most installations.

Step 6. Terminating the SCSI chain

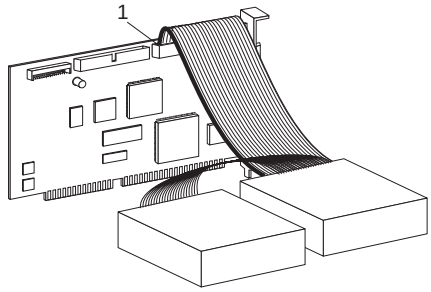
> **Note:** Do not confuse termination power with device termination. The SCSI adapter normally supplies termination power and the SCSI device terminates the chain. For more information about termination power, see the documentation that comes with your SCSI adapter.

A SCSI device chain is made up of one or more SCSI devices connected by a SCSI cable to a SCSI adapter. To prevent signal reflections on the SCSI cable, the SCSI device chain must be terminated with active terminators at both ends; there are no exceptions.

Termination is also subject to the following guidelines:

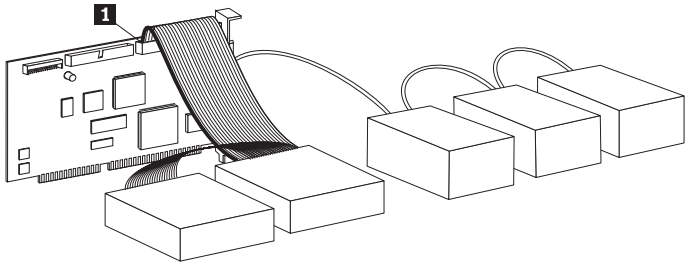
- Ultra2 and Ultra160 SCSI drives do not provide termination.

- Be sure to terminate only the ends of the SCSI chain. For example, the last device and the SCSI adapter shown in the diagram below must be terminated.



- Remove any terminators or terminating jumpers on devices in the middle of the chain.

  In the diagram below, the SCSI adapter **1** is in the middle of the chain and is not terminated.



- You cannot end the SCSI chain with devices that use passive termination, such as some CD-ROM drives, tape drives, and optical drives.
- Only one device, the device at the end of the SCSI cable, a 68-pin device, can be terminated.
- If the SCSI cable is not self-terminating, 50-pin devices connected by pin converters cannot be at the end of the chain.
- If the hard disk drive in an external enclosure needs termination, attach an external terminator to the connector on the enclosure at the end of the chain. Do not install an additional termination jumper on the device inside the enclosure.
- You must use LVD terminators with SCSI device chains that include LVD devices (such as Ultra2 or Ultra160 drives). If you use another type of termination device, the drive can only transfer data at pre-Ultra2 rates.

Use the following table to determine a termination solution for your drive.

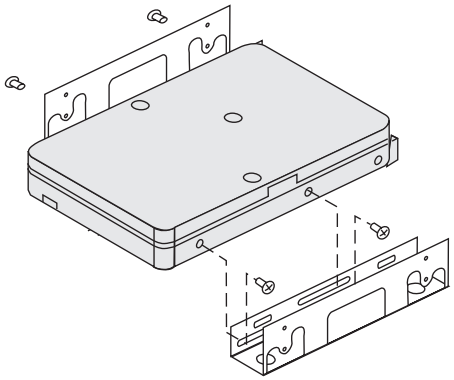
Cabling scenario	Termination solution
Computer system with self-terminating SCSI cable	Simply add the drive to the system; the cable provides termination.
Computer system with the last SCSI device terminating the chain	Add the drive, but not at the end of the chain; the last SCSI device provides termination.
The drive will be the only device on a single-drop cable	1. Obtain a Method inline terminator.[1] 2. Attach the inline terminator to the drive, and connect the drive to the single-drop cable. **Note:** Adding the inline terminator will limit the maximum data transfer speed to 40 MBps. .
Drive is added in a single drive enclosure (such as the IBM External Half-High SCSI Storage Enclosure)	Obtain an external LVD termination device and connect it to the termination connector at the rear of the enclosure.

Step 7. Preparing the drive for a 5.25-inch bay

Attention: Use the mounting screws that come with the drive to attach the brackets to the drive. Using the wrong size screws might damage the drive.

To install the drive in a 5.25-inch bay:

1. Attach a pair of 3.5-inch to 5.25-inch expansion brackets (not included in this option package), as shown in the illustration.



[1] You can purchase an inline active terminator, such as the Method DM6100-02-68 ADR, from Technical Cable Concepts, Inc. (1-800-832-2225 or 1-714-835-1081).

These brackets are available in the IBM 3.5-inch to 5.25-inch conversion kit, IBM part number 70G8165. Refer to the documentation that comes with the conversion kit for instructions on using the expansion brackets.

2. Attach the drive with expansion brackets into the bay. Some computers require special hard disk drive mounting hardware to ensure that the drive fits securely into the bay. Contact your computer dealer or refer to the documentation that comes with your computer if you need specialized mounting hardware or more information.

Step 8. Mounting the drive in the bay

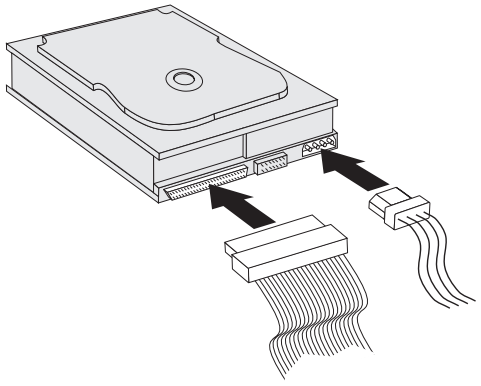
To mount the drive in a horizontal or a vertical bay:

1. Slide the drive into the bay.
2. Align the drive-bay screw holes with the threaded holes in the drive housing (or bracket).
3. Use the mounting screws in the option package or the special screws with grommets provided with some IBM computer systems; using other screws might damage the drive. Thread the screws to loosely attach the drive to the bay. Usually two screws are used on each side. Some installations use the screw holes on the bottom (circuit board side) of the drive.
4. Check the drive alignment and tighten the screws. Do not overtighten.

Step 9. Attaching the cables to the drive

The connector on one end of the internal SCSI cable connects to the hard disk drive and the other end connects to the SCSI adapter. For the best signal quality, use the free device connector that gives you the maximum amount of cable between the drive and the SCSI adapter. The SCSI adapter can be on the system board or it can be installed in an expansion slot.

1. Locate a free device connector on the SCSI cable. One end of the SCSI cable connects to the SCSI adapter and the other end has connectors for attaching multiple SCSI devices.



2. Attach an available connector on the SCSI cable to the connector on the hard disk drive, as shown.

   If you are connecting your new drive to a SCSI adapter that has 68-pin D-shell connectors, the connector is narrower at the top and will fit only one way.

Attention: Do not force the power connector into the drive. If the connector does not seat using reasonable pressure, turn it around and try again.

3. Find an unattached power connector coming from the computer power supply and attach it to the four-pin dc power connector on the back of the drive, as shown.

   If all power cables are in use, purchase a dc Y-connector (available at most electronic stores) and split a connection to make room for more devices.

Step 10. Closing the computer

To complete the hardware section of the drive installation:

1. Be sure that the hard disk drive is securely mounted and the connectors are firmly attached.
2. Be sure the cables do not interfere with the computer cover and do not block the power-supply fan blades or air-flow paths.
3. Reinstall the computer cover.
4. Reconnect all devices.
5. Check your keyboard, mouse, and monitor for loose connections.
6. Plug all power cords into electrical outlets.

The first time you restart your computer after installing the new drive, you might have to use the SCSI adapter utility program to update the configuration information.

Notes:

1. If you are installing the primary drive in a Micro Channel® computer, you might have to restore the IML or System Partition using your Reference and Diagnostic Diskettes.
2. If you are installing a secondary drive in a Micro Channel computer, you must configure the drive using your System Partition or Reference Diskette.

   Refer to your operating system documentation for more information about Micro Channel requirements.

Partitioning and formatting the drive

Attention: Partitioning and formatting a hard disk drive erases all user data on the drive.

You must partition and format the hard disk drive before you can use it. If you want to start your operating system from the drive (primary drive), the drive must have an active primary partition (normally C). You can use the remaining space on the drive for an extended partition that you can divide into logical drives.

In most computers that have an IDE hard disk drive, you cannot restart the computer from the SCSI hard disk drive. Normally, only the primary partition on the IDE drive can be active (contains your operating system and is used for startup) and only the active partition can be used as the startup drive. If your SCSI hard disk drive contains a primary partition, it must be inactive. If you are unsure about restarting your computer from the SCSI hard disk drive, see the documentation that comes with your computer and SCSI adapter.

Each operating system has unique directions for partitioning and formatting a drive. Be sure to refer to the documentation that comes with your operating system before continuing with the instructions below.

Partitioning and formatting using the NT file system for Windows NT, Windows 2000 Server, and Windows 2000 Professional

If you add your drive to a computer that has the Windows NT, Windows 2000 Server, or Windows 2000 Professional operating system on an existing drive, follow the instructions below to partition and format your new SCSI drive using the NTFS (NT File System) convention.

1. Turn on your computer.
2. Click **Start → Programs → Administrative Tools (Common) → Disk Administrator**.
3. Follow the screen prompts to partition and format an additional hard disk drive.

If you install your drive in a computer that has no previously existing hard drive, follow the instructions below to partition and format your new SCSI drive for the Windows NT operating system using NTFS.

1. Insert the first installation diskette (*Setup Disk #1*) in the diskette drive or insert the installation CD into the CD-ROM drive.
2. Restart your computer.
3. Follow the instructions in the operating system user's guide to partition and format your drive.

Partitioning and formatting using the FAT32 convention for Windows 95 OSR2, Windows 98, and Windows 2000 Professional

The latest releases of Microsoft operating systems, including Windows 2000 Professional, Windows 98, and Windows 95 OSR2, have an option for a 32-bit file allocation table called FAT32. FAT32 supports partitions as large as 2 TB[2] and cluster sizes of 4 KB[3] for partitions up to 8 GB.[4] If you have FAT32, you will be able to prepare your drive without concern for partition size limits or storage efficiency. To determine if you have FAT32 installed, right-click your existing drive under **My Computer**, and select **Properties**. If FAT32 is installed, the **General** tab will show **FAT32** under the drive label.

Refer to your operating system user's guide for specific information about partitioning and formatting a drive using Windows 98, Windows 95, or Windows 2000 Professional.

Partitioning and formatting using the high performance file system for OS/2

If you are using OS/2, you can use the high performance file system (HPFS) developed for OS/2, instead of the FAT16 file system, to partition an additional drive. HPFS allocates files in 512-byte units, reducing lost disk space. HPFS also creates large partitions and accommodates large numbers of files more efficiently than FAT16 does. For information on partitioning a drive using FAT16, go to "Partitioning and formatting using FAT16 convention for DOS and Windows 3.x" on page 1-14.

To prepare the new drive using OS/2:

1. Partition and format your new drive for OS/2 using the FAT16 or HPFS file system, or both FAT16 and HPFS, using directions given in the OS/2 *User's Guide*.

   Note: In larger capacity drives, the OS/2 operating system can partition only up to the first 2.14 GB, or the first 1024 logical cylinders, of the drive using the FAT file system. However, you can partition the entire drive using the HPFS file system.

   Since you cannot partition the entire capacity of the drive when using FAT, you must use HPFS to partition the rest of the drive.

   For more information on partition size limits for FAT16, see "Selecting a primary partition or logical drive size" on page 1-14.

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2 When referring to hard-disk-drive capacity, TB (terabyte) means 1 000 000 000 000 bytes; total user-accessible capacity may vary depending on operating system.

3 When referring to cluster sizes, KB (kilobyte) means 1 024 bytes.

4 When referring to hard-disk-drive-capacity, GB (gigabyte) means 1 000 000 000 bytes; total user-accessible capacity may vary depending on operating system.

2. If you choose to make your new drive a boot drive, refer to your OS/2 *User's Guide* for information on installing OS/2 on your new drive.

If you use the DOS-based Fixed Disk Setup Program (FDISK) utility to partition your drive and you are using the maximum partition size of 2.14 GB, you must enter the partition size as 2047 MB. (FDISK uses the software industry binary-base number system where one binary MB equals 1 048 576 bytes.)

Partitioning and formatting using FAT16 convention for DOS and Windows 3.x

The largest partition size that you can create using the 16-bit file allocation table (FAT16) file is approximately 2.14 GB.

If you are installing a drive larger than 2.14 GB and you are using the FAT16 convention, you must create multiple partitions.

To create multiple partitions:

- Select a primary partition size and create the primary partition.
- Create an extended logical partition using the remaining space on the drive.
- Create one or more logical drives in the extended partition.

If you are using FDISK to create partitions and logical drives and you want to create the maximum size primary partition or logical drive (2.14 GB), you must specify the size as 2047 MB. (FDISK uses the software industry binary-base number system where one binary MB equals 1 048 576 bytes.)

Note: If you are installing the hard disk drive that will contain your primary partition, install the operating system as part of the installation procedure.

Selecting a primary partition or logical drive size

Base your partitions and partition sizes on how you use your computer.

- Use a larger partition size for the convenience of having many files in one directory structure or for large databases.
- A smaller partition size makes better use of space if you have a large number of small files, such as text files.

FDISK assigns space on a hard disk drive in clusters. A cluster is the smallest unit of space on the drive that your operating system, using FAT conventions, can address. The operating system assigns a file to one or more clusters. Even a very small file uses a full cluster.

The following table shows how the cluster size is incremented as the partition size increases.

Partition Size	Cluster Size (FAT16)
0 MB - 16 MB	4 KB
16 MB - 128 MB	2 KB
128 MB - 256 MB	4 KB
256 MB - 512 MB	8 KB
512 MB - 1 GB	16 KB
1 GB - 2 GB	32 KB

These examples illustrate how partition size relates to data storage efficiency.

- If you create a 2.14 GB partition (2047 binary MB), each disk cluster is 32 KB. (In binary notation, KB equals 1 024 bytes.) A 1 KB file uses one cluster (32 KB) of disk space.
- If the partition size is 1.00 GB (977 binary MB), the cluster size is 16 KB. A 1 KB file uses one cluster (16 KB) of disk space.

A normal mix of application and data files can include thousands of different-sized files. If you replace your disk drive with a larger capacity drive, normally you will create a larger primary partition or logical drive on the new device. When you copy files from a smaller to a larger partition, the same files might take surprisingly more disk space. The increase in disk space for the same files is caused by the increase in cluster size.

Preparing the primary drive for DOS or Windows 3.x

If you are installing the drive that will contain your operating system (the primary drive), find your operating system installation diskettes and insert the first operating system installation diskette into the diskette drive (or insert the operating system installation CD if your operating system is installed from the CD-ROM drive). Restart your computer. The operating system screens lead you through partitioning and formatting the drive.

After creating the primary partition, you can use the remaining disk space for an extended partition. Follow the instructions on the screen to create one or more logical drives within the extended partition.

Preparing a secondary drive for DOS or Windows 3.x

A secondary drive is any hard disk drive that does not contain the active primary partition (the partition that contains your operating system). Normally you allocate all of the disk space on a secondary drive to an extended partition and then create logical drives in the extended partition. For more information about creating partitions see the documentation that comes with your operating system.

The following example uses the FDISK and FORMAT commands to partition and format an extended partition on a secondary hard disk drive.

1. At the DOS prompt, type `fdisk` and press Enter.

2. FDISK displays the current fixed-disk drive message, containing the current fixed-disk drive number, above the FDISK menu. The fixed-disk drive number is not associated with the logical drive letters assigned by FDISK. Check the current fixed disk drive number to be sure that you partition the correct hard disk drive.

   The default current fixed disk drive is the fixed disk drive containing the active primary partition (drive C). To change the fixed disk drive number for the secondary drive:

   a. From the FDISK menu, select **Change current fixed disk**.
   b. From the drive list, select the new drive number.
   c. Return to the FDISK menu.

3. Select **Create DOS partition or Logical DOS Drive** and press Enter.
4. Select **Create Extended DOS Partition** and press Enter. The default size is the remaining space on the drive. You must accept the default size to use the full capacity of your drive.
5. The Create Logical DOS Drive(s) in the Extended DOS Partition screen displays. Follow the instructions on the screen to create one or more logical drives within the extended partition.
6. When you are finished, press ESC to return from the FDISK menu.
7. When you are prompted, restart your computer and format your logical drives.
8. To format a logical drive, type `format x:` (where *x* is the logical drive letter assigned by FDISK) at the DOS prompt and press Enter.

Copying files to your new primary drive

> **Note:** This procedure is included as an alternate method for transferring files from one hard disk drive to another. If you are not sure about your operating system configuration parameters or about applications or files that might be open, do not use this procedure.

If you are replacing your primary drive, you can install your operating system and other applications on your new primary drive. As an alternative, you can use the following procedure to copy your installed operating system and applications from your old primary drive to your new primary drive.

1. Leave your existing primary hard disk drive installed and install your new drive as a second drive.
2. Use FDISK to create a primary partition on the new drive. You can have only one active primary partition on the computer so this will be an inactive primary partition.
3. Exit FDISK and restart your computer. FDISK assigns a drive letter to the inactive partition. Use the FORMAT command to format the new drive.
4. Use XCOPY to copy directories and files from the C drive to your inactive primary partition on the new drive. For information about XCOPY options, see

the documentation that comes with your operating system. Before you run XCOPY, close all other applications including Windows. If an active application locks data files, the files might not be copied.

5. Open FDISK and display the current drive partitioning information. Select the current startup partition drive number and make this partition inactive (you no longer can restart from this partition).

   Select the new drive number and make its primary partition active.

6. Press ESC to exit FDISK. Restart your computer when prompted.

7. Turn off your computer and disconnect the power cord. Open up the computer and set the SCSI ID for the new drive to the ID your SCSI adapter requires for the primary drive, for example, SCSI ID 0 or 6. To avoid duplicate SCSI IDs for the two drives, remove the original startup drive or change the SCSI ID of the original drive.

8. Close the computer, reconnect the power cord, and restart the computer. The computer starts from the primary partition on the new drive.

If files are not copied correctly from your old drive, your computer might not start correctly. If this happens you must reinstall your operating system on the new drive. For more information, see the documentation that comes with your operating system.

Installation and user's guide (Translate)

This section contains the product description and detailed installation instructions.

Product description

Your SCSI hard disk drive is a new Ultra2 or Ultra160 SCSI device that uses low-voltage differential (LVD) signal transmission that can accelerate data transfer speed and lengthen a SCSI device chain. Ultra2 SCSI devices, working only with other Ultra2/Ultra160 SCSI devices on a SCSI device chain, support a maximum instantaneous data transfer rate of 80 MBps (Megabytes per second). Ultra160 SCSI devices, working only with other Ultra2 or Ultra160 devices on a SCSI device chain, support a maximum instantaneous data transfer rate of 160 MBps. You can also connect up to 16 Ultra2 or Ultra160 SCSI devices together on a SCSI device cable that can be as long as 12 m (39 ft). Ultra2 and Ultra160 SCSI drives also have single-ended transceivers that enable the drives to work with single-ended SCSI devices. However, when an Ultra2 or Ultra160 SCSI drive is connected with single-ended devices on a SCSI device chain, the maximum data transfer rate is reduced to 40 MBps, and the maximum SCSI cable length for the device chain is reduced to 3 m (10 ft) when fewer than four devices are on the chain or 1.5 m (5 ft) when four or more devices are on the chain.

Your Ultra2 or Ultra160 SCSI drive meets the Small Computer System Interface (SCSI) standard set by the American National Standards Institute (ANSI), and can be installed only in a computer that uses the SCSI architecture.

You can configure your new SCSI hard disk drive in any of the following ways:

- Single-drive configuration
  - To add a hard disk drive to a computer
  - To replace an installed hard disk drive
- Multiple-drive configuration
  - To operate with installed IDE hard disk drives
  - To operate with installed SCSI hard disk drives

In addition to this book, this option package contains:

- SCSI hard disk drive
- Option jumpers
- Mounting screws
- *SCSI Hard Disk Drive User's Guide Supplement*
- Safety information manual

Contact your place of purchase if any parts are missing or damaged. Be sure to retain your proof of purchase; it might be required to receive warranty service.

Preparing for installation

This section contains information on how to prepare for installation. To install the SCSI hard disk drive you need the following:

Documentation
The documentation that comes with your computer, SCSI adapter, and operating system.

SCSI adapter and SCSI cable
Your computer must have a SCSI adapter and a SCSI cable with an available interface connector. If you are not sure about your computer interface type, see the documentation that comes with your computer.

Drive mounting location
The hard disk drive you are installing is designed for a 3.5-inch bay, but it can be adapted to fit into a 5.25-inch bay.

To mount the hard disk drive in a 5.25-inch bay, you will need to attach 3.5-inch-to-5.25-inch conversion hardware (not included). You can purchase a conversion kit (IBM part number 70G8165) from your IBM reseller. You might need flat-blade and Phillips-head screwdrivers to install the drive.

Some installations also require mounting rails or other special hardware in addition to the conversion hardware.

Software
One of the following operating systems:

- Microsoft® Windows® 2000 Professional or Windows 2000 Server
- Windows NT® Workstation
- Windows 98
- Windows 95 OSR2
- Windows 3.x
- IBM OS/2®
- DOS 5.0 or later

Backing up files

If you are replacing an installed hard disk drive, make a backup copy of the data from the drive that you are replacing.

You can use the XCOPY program to copy groups of files, including directories and subdirectories, from one drive to another. If the destination already contains a file or directory with the same name, XCOPY prompts you for a decision about overwriting the file. If you need more information about XCOPY or backing up your hard disk drive, see “Copying files to your new primary drive” on page 1-33, or the documentation that comes with your operating system.

Creating a system diskette

If your computer will not restart, you might be able to recover by using a System Diskette. The System Diskette allows you to recover if you cannot restart (boot) your computer from a previously installed hard disk drive, and you do not have a backup diskette. When you restart your computer, the Basic Input/Output System (BIOS) checks the diskette drive for a System Diskette before it checks the primary partition on the hard disk drive.

The System Diskette contains the minimum set of files needed to start your computer. In addition to the minimum set of files, you might want to copy other useful files, such as FDISK, FORMAT, XCOPY, CHKDSK, and MEM, to the System Diskette.

To create a System Diskette for DOS:

1. Insert a blank diskette into drive A.
2. At the DOS prompt, type `format a: /s`. The `/s` parameter creates the System Diskette.
3. Follow the on-screen instructions.
4. When the format process completes, copy the FDISK.COM, FORMAT.COM, DISKCOPY.EXE, CHKDSK.COM, and MEM.EXE utility programs from the DOS directory to the diskette.

To create a System Diskette for Windows 98 or Windows 95:

1. Click **Start → Settings → Control Panel**.
2. From the Control Panel window, double-click **Add/Remove Programs**.
3. Click the **Startup Disk** tab.
4. Follow the instructions on your screen.

To create Utility (System) Diskettes for OS/2:

1. Double-click **OS/2 System** on your Desktop.
2. Double-click **System Setup**.
3. Double-click **Create Utility Diskettes**. The Create Utility Diskettes window opens.
4. Follow the instructions on your screen. OS/2 creates three Utility Diskettes.

You can also create the Utility Diskettes from the OS/2 CD-ROM by running CDINST.CMD from the file directory.

Installing the drive

These instructions are general guidelines for installing the IBM SCSI Hard Disk Drive in most computers. For specific information, see the documentation that comes with your computer.

Note: If you are installing the SCSI hard disk drive in a disk-array system, do not use these installation instructions. See the instructions that come with the disk-array system.

Step 1. Selecting a SCSI ID

Each SCSI device, including the SCSI adapter, must be assigned a SCSI identification number (ID). Use the following table as a guideline for selecting the best SCSI ID for your device:

SCSI device	Best SCSI ID
Tape drive	0
CD-ROM drive	1
High-density diskette drive	2
Removable hard drive	3
Third hard disk drive	4
Second hard disk drive	5
Startup hard disk drive	6
SCSI adapter	7
Additional hard disk drives	15 through 8 (decreasing order of priority)

For more information on setting SCSI IDs, use the following guidelines.

- You cannot assign the same ID to multiple devices on the same SCSI adapter.
- The ID you assign to your new drive depends on the number of SCSI devices connected to the SCSI adapter, the SCSI IDs already assigned to those devices, and the maximum number of IDs for your SCSI adapter.
- SCSI ID 7 is normally reserved for the SCSI adapter.
- Assign the higher priority SCSI IDs (the highest priority is normally 6) to devices, such as hard disk drives, that are faster and are used the most. Assign lower priority SCSI ID numbers to slower SCSI devices, such as CD-ROM drives and tape drives. SCSI ID priorities are assigned by the SCSI adapter.
- Narrow SCSI devices (devices with 50-pin connectors) such as high-density diskette drives, CD-ROM drives, smaller tape drives and removable hard drives can only connect to the wide SCSI device chain using a 50-to-68 pin connector, or through a separate 50-pin conductor cable. These narrow devices only use SCSI ID addresses from 0 to 6, and they must be assigned to the lowest priority SCSI ID's available in that range.
- Most IBM computer systems come with the SCSI adapter preset to look to SCSI ID 6 for the startup drive that contains your operating system.

- Before you install the drive, determine which SCSI IDs are already assigned to avoid assigning duplicate ID numbers.

Note: Most narrow 50-pin SCSI devices are pre-Ultra2 SCSI devices. When pre-Ultra2 SCSI devices are added to an Ultra160 or Ultra2 device chain, the maximum burst data rate for the Ultra160 or Ultra2 SCSI drives attached to that device chain will be reduced from 160 MBps (Ultra160) or 80 MBps (Ultra2) to 40 MBps.

If you have multiple high performance drives and data-rate sensitive software, you need to purchase a separate adapter for the pre-Ultra2 SCSI devices (such as the IBM PCI Fast/Wide Ultra SCSI Adapter, P/N 02K3454).

Step 2. Opening the computer

Turn off the computer and unplug the power cords for the computer and all attached devices. Open the computer. For specific information on opening your computer see the documentation that comes with your computer.

If you are replacing your primary hard disk drive, copy the files from that drive using the instructions given in “Copying files to your new primary drive” on page 1-33 before you disconnect it.

Step 3. Unpacking the drive

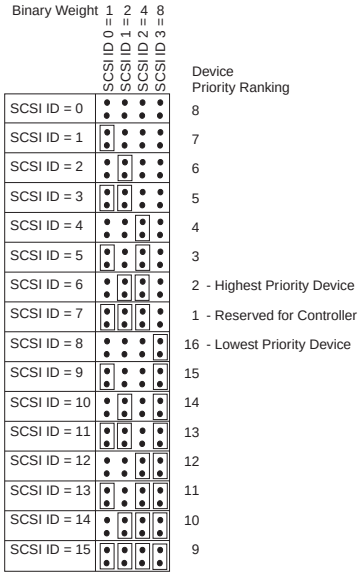
Use the following procedure to unpack and handle the drive. To prevent damage to the drive, limit handling to a minimum.

1. Before opening the static-protective bag containing the drive, touch the bag and your hand to an unpainted metal surface on the computer for at least two seconds.
2. Remove the drive from the static-protective bag and handle it by the edges. Do not touch any exposed components on the drive.
3. If you must put the drive down, place the static-protective bag on a flat padded surface, such as a magazine, and place the drive on the bag with the component side facing up.

Step 4. Setting the SCSI ID for the drive

Set the SCSI ID for your drive by placing jumpers on the appropriate drive jumper pins. See your *SCSI Hard Disk Drive User's Guide Supplement* and the diagram below for information on SCSI ID jumper placement.

Note: The alignment of the jumper pins on the diagram might be the reverse of the alignment of the jumper pins on your drive. Be sure to use the *SCSI Hard Disk Drive User's Guide Supplement* to confirm the correct jumper placement.



Save any spare jumpers; you might have to change the SCSI ID. Refer to the *SCSI Hard Disk Drive User's Guide Supplement* to determine if you can safely store spare jumpers on the drive jumper pins.

Step 5. Determining whether to disable Auto Start or Auto Spinup

Note: Be sure that Auto Start is disabled when you are installing the hard disk drive in an IBM server.

Refer to the *SCSI Hard Disk Drive User's Guide Supplement* to determine if Auto Start (also called Auto Spinup or Motor Start) is enabled on your drive jumper pins. If Auto Start is enabled, this attached drive starts at once when the computer is turned on. However, starting two or more drives simultaneously might overload the computer power supply. If you want to sequence drive startup to flatten the power peak required for drive startup, be sure that Auto Start is disabled. If Auto Start is disabled, the drive is prevented from starting until it receives the Start Unit command from the SCSI adapter. Most SCSI adapters send the Start Unit commands to the drives sequentially from SCSI ID 0 to SCSI ID 15.

If you are using an IBM computer, use the following instructions to verify that the SCSI adapter will send the Start Unit command to your drive.

1. Turn on your computer.
2. Press Ctrl+A during the SCSI Adapter Power-on self-test (POST) window.
3. Select **Configure/View Host Adapter Settings** and then press Enter.
4. Select **SCSI Device Configurations** and then press Enter.
5. Be sure that **yes** is selected for **Send Start Unit Command** under the SCSI ID assigned to your drive.
6. Press Esc twice to save changes.
7. Select **Yes** to exit Utilities.

For more information, refer to the specifications for your drive and power supply.

For more information about drive startup, see the documentation that comes with your SCSI adapter.

For SCSI adapters that do not send the Start Unit command, see the documentation that comes with your SCSI adapter.

Installing other jumpers

Spindle Sync, Parity Disable, Write Protect, Auto Start Delay, Disable Unit Attention, and other jumper positions that might be on the drive jumper block are not needed for most installations.

Step 6. Terminating the SCSI chain

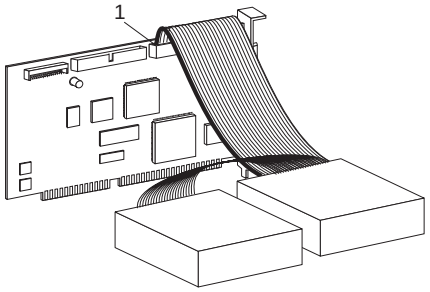
> **Note:** Do not confuse termination power with device termination. The SCSI adapter normally supplies termination power and the SCSI device terminates the chain. For more information about termination power, see the documentation that comes with your SCSI adapter.

A SCSI device chain is made up of one or more SCSI devices connected by a SCSI cable to a SCSI adapter. To prevent signal reflections on the SCSI cable, the SCSI device chain must be terminated with active terminators at both ends; there are no exceptions.

Termination is also subject to the following guidelines:

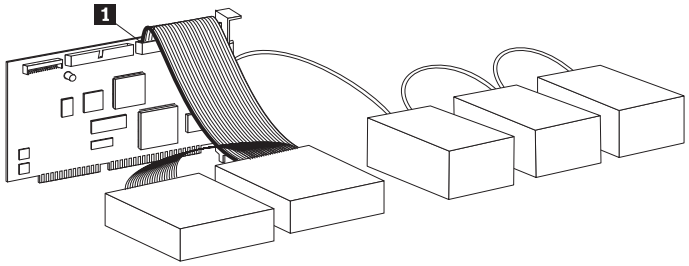
- Ultra2 and Ultra160 SCSI drives do not provide termination.

- Be sure to terminate only the ends of the SCSI chain. For example, the last device and the SCSI adapter shown in the diagram below must be terminated.



- Remove any terminators or terminating jumpers on devices in the middle of the chain.

  In the diagram below, the SCSI adapter **1** is in the middle of the chain and is not terminated.



- You cannot end the SCSI chain with devices that use passive termination, such as some CD-ROM drives, tape drives, and optical drives.
- Only one device, the device at the end of the SCSI cable, a 68-pin device, can be terminated.
- If the SCSI cable is not self-terminating, 50-pin devices connected by pin converters cannot be at the end of the chain.
- If the hard disk drive in an external enclosure needs termination, attach an external terminator to the connector on the enclosure at the end of the chain. Do not install an additional termination jumper on the device inside the enclosure.
- You must use LVD terminators with SCSI device chains that include LVD devices (such as Ultra2 or Ultra160 drives). If you use another type of termination device, the drive can only transfer data at pre-Ultra2 rates.

Use the table below to determine a termination solution for your drive.

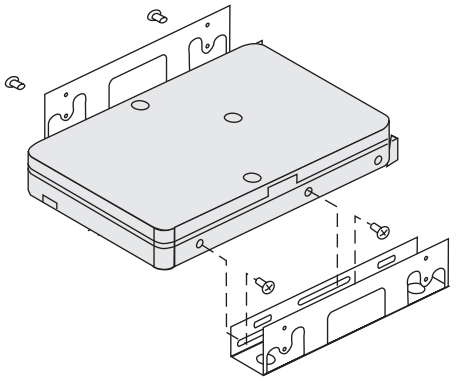
Cabling scenario	Termination solution
Computer system with self-terminating SCSI cable	Simply add the drive to the system; the cable provides termination.
Computer system with the last SCSI device terminating the chain	Add the drive, but not at the end of the chain; the last SCSI device provides termination.
The drive will be the only device on a single-drop cable	1. Obtain an inline terminator. 2. Attach the inline terminator to the drive, and connect the drive to the single-drop cable. **Note:** Adding the inline terminator will limit the maximum data transfer speed to 40 MBps. .
Drive is added in a single drive enclosure (such as the IBM External Half-High SCSI Storage Enclosure)	Obtain an external LVD termination device and connect it to the termination connector at the rear of the enclosure.

Step 7. Preparing the drive for a 5.25-inch bay

Attention: Use the mounting screws that come with the drive to attach the brackets to the drive. Using the wrong size screws might damage the drive.

To install the drive in a 5.25-inch bay:

1. Attach a pair of 3.5-inch to 5.25-inch expansion brackets (not included in this option package), as shown in the illustration.



These brackets are available in the IBM 3.5-inch to 5.25-inch conversion kit, IBM part number 70G8165. Refer to the documentation that comes with the conversion kit for instructions on using the expansion brackets.

2. Attach the drive with expansion brackets into the bay. Some computers require special hard disk drive mounting hardware to ensure that the drive fits securely into the bay. Contact your computer dealer or refer to the documentation that comes with your computer if you need specialized mounting hardware or more information.

Step 8. Mounting the drive in the bay

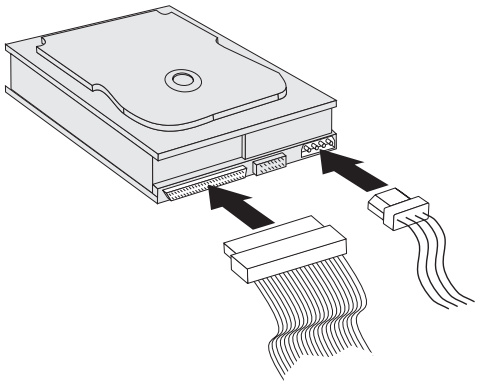
To mount the drive in a horizontal or a vertical bay:

1. Slide the drive into the bay.
2. Align the drive-bay screw holes with the threaded holes in the drive housing (or bracket).
3. Use the mounting screws in the option package or the special screws with grommets provided with some IBM computer systems; using other screws might damage the drive. Thread the screws to loosely attach the drive to the bay. Usually two screws are used on each side. Some installations use the screw holes on the bottom (circuit board side) of the drive.
4. Check the drive alignment and tighten the screws. Do not overtighten.

Step 9. Attaching the cables to the drive

The connector on one end of the internal SCSI cable connects to the hard disk drive and the other end connects to the SCSI adapter. For the best signal quality, use the free device connector that gives you the maximum amount of cable between the drive and the SCSI adapter. The SCSI adapter can be on the system board or it can be installed in an expansion slot.

1. Locate a free device connector on the SCSI cable. One end of the SCSI cable connects to the SCSI adapter and the other end has connectors for attaching multiple SCSI devices.



2. Attach an available connector on the SCSI cable to the connector on the hard disk drive, as shown.

If you are connecting your new drive to a SCSI adapter that has 68-pin D-shell connectors, the connector is narrower at the top and will fit only one way.

Attention: Do not force the power connector into the drive. If the connector does not seat using reasonable pressure, turn it around and try again.

3. Find an unattached power connector coming from the computer power supply and attach it to the four-pin dc power connector on the back of the drive, as shown.

   If all power cables are in use, purchase a dc Y-connector (available at most electronic stores) and split a connection to make room for more devices.

Step 10. Closing the computer

To complete the hardware section of the drive installation:

1. Be sure that the hard disk drive is securely mounted and the connectors are firmly attached.
2. Be sure the cables do not interfere with the computer cover and do not block the power-supply fan blades or air-flow paths.
3. Reinstall the computer cover.
4. Reconnect all devices.
5. Check your keyboard, mouse, and monitor for loose connections.
6. Plug all power cords into electrical outlets.

The first time you restart your computer after installing the new drive, you might have to use the SCSI adapter utility program to update the configuration information.

Notes:

1. If you are installing the primary drive in a Micro Channel® computer, you might have to restore the IML or System Partition using your Reference and Diagnostic Diskettes.
2. If you are installing a secondary drive in a Micro Channel computer, you must configure the drive using your System Partition or Reference Diskette.

   Refer to your operating system documentation for more information about Micro Channel requirements.

Partitioning and formatting the drive

Attention: Partitioning and formatting a hard disk drive erases all user data on the drive.

You must partition and format the hard disk drive before you can use it. If you want to start your operating system from the drive (primary drive), the drive must have an

active primary partition (normally C). You can use the remaining space on the drive for an extended partition that you can divide into logical drives.

In most computers that have an IDE hard disk drive, you cannot restart the computer from the SCSI hard disk drive. Normally, only the primary partition on the IDE drive can be active (contains your operating system and is used for startup) and only the active partition can be used as the startup drive. If your SCSI hard disk drive contains a primary partition, it must be inactive. If you are unsure about restarting your computer from the SCSI hard disk drive, see the documentation that comes with your computer and SCSI adapter.

Each operating system has unique directions for partitioning and formatting a drive. Be sure to refer to the documentation that comes with your operating system before continuing with the instructions below.

Partitioning and formatting using the NT file system for Windows NT, Windows 2000 Server, and Windows 2000 Professional

If you add your drive to a computer that has the Windows NT, Windows 2000 Server, or Windows 2000 Professional operating system on an existing drive, follow the instructions below to partition and format your new SCSI drive using the NTFS (NT File System) convention.

1. Turn on your computer.
2. Click **Start → Programs → Administrative Tools (Common) → Disk Administrator**.
3. Follow the screen prompts to partition and format an additional hard disk drive.

If you install your drive in a computer that has no previously existing hard drive, follow the instructions below to partition and format your new SCSI drive for the Windows NT operating system using NTFS.

1. Insert the first installation diskette (*Setup Disk #1*) in the diskette drive or insert the installation CD into the CD-ROM drive.
2. Restart your computer.
3. Follow the instructions in the operating system user's guide to partition and format your drive.

Partitioning and formatting using the FAT32 convention for Windows 95 OSR2, Windows 98, and Windows 2000 Professional

The latest releases of Microsoft operating systems, including Windows 2000 Professional, Windows 98, and Windows 95 OSR2, have an option for a 32-bit file allocation table called FAT32. FAT32 supports partitions as large as 2 TB[5] and cluster sizes of 4 KB[6] for partitions up to 8 GB.[7] If you have FAT32, you will be able to prepare your drive without concern for partition size limits or storage efficiency. To determine if you have FAT32 installed, right-click your existing drive under **My Computer**, and select **Properties**. If FAT32 is installed, the **General** tab will show **FAT32** under the drive label.

Refer to your operating system user's guide for specific information about partitioning and formatting a drive using Windows 98, Windows 95, or Windows 2000 Professional.

Partitioning and formatting using the high performance file system for OS/2

If you are using OS/2, you can use the high performance file system (HPFS) developed for OS/2, instead of the FAT16 file system, to partition an additional drive. HPFS allocates files in 512-byte units, reducing lost disk space. HPFS also creates large partitions and accommodates large numbers of files more efficiently than FAT16 does. For information on partitioning a drive using FAT16, go to "Partitioning and formatting using the FAT16 convention for DOS and Windows 3.x" on page 1-31.

To prepare the new drive using OS/2:

1. Partition and format your new drive for OS/2 using the FAT16 or HPFS file system, or both FAT16 and HPFS, using directions given in the OS/2 *User's Guide*.

   Note: In larger capacity drives, the OS/2 operating system can partition only up to the first 2.14 GB, or the first 1024 logical cylinders, of the drive using the FAT file system. However, you can partition the entire drive using the HPFS file system.

   Since you cannot partition the entire capacity of the drive when using FAT, you must use HPFS to partition the rest of the drive.

   For more information on partition size limits for FAT16, see "Selecting a primary partition or logical drive size" on page 1-31.

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5 When referring to hard-disk-drive capacity, TB (terabyte) means 1 000 000 000 000 bytes; total user-accessible capacity may vary depending on operating system.

6 When referring to cluster sizes, KB (kilobyte) means 1 024 bytes.

7 When referring to hard-disk-drive-capacity, GB (gigabyte) means 1 000 000 000 bytes; total user-accessible capacity may vary depending on operating system.

2. If you choose to make your new drive a boot drive, refer to your OS/2 *User's Guide* for information on installing OS/2 on your new drive.

If you use the DOS-based Fixed Disk Setup Program (FDISK) utility to partition your drive and you are using the maximum partition size of 2.14 GB, you must enter the partition size as 2047 MB. (FDISK uses the software industry binary-base number system where one binary MB equals 1 048 576 bytes.)

Partitioning and formatting using the FAT16 convention for DOS and Windows 3.x

The largest partition size that you can create using the 16-bit file allocation table (FAT16) file is approximately 2.14 GB.

If you are installing a drive larger than 2.14 GB and you are using the FAT16 convention, you must create multiple partitions.

To create multiple partitions:

- Select a primary partition size and create the primary partition.
- Create an extended logical partition using the remaining space on the drive.
- Create one or more logical drives in the extended partition.

If you are using FDISK to create partitions and logical drives and you want to create the maximum size primary partition or logical drive (2.14 GB), you must specify the size as 2047 MB. (FDISK uses the software industry binary-base number system where one binary MB equals 1 048 576 bytes.)

> **Note:** If you are installing the hard disk drive that will contain your primary partition, install the operating system as part of the installation procedure.

Selecting a primary partition or logical drive size

Base your partitions and partition sizes on how you use your computer.

- Use a larger partition size for the convenience of having many files in one directory structure or for large databases.
- A smaller partition size makes better use of space if you have a large number of small files, such as text files.

FDISK assigns space on a hard disk drive in clusters. A cluster is the smallest unit of space on the drive that your operating system, using FAT conventions, can address. The operating system assigns a file to one or more clusters. Even a very small file uses a full cluster.

The following table shows how the cluster size is incremented as the partition size increases.

Partition Size	Cluster Size (FAT16)
0 MB - 16MB	4 KB
16 MB - 128 MB	2 KB
128 MB - 256 MB	4 KB
256 MB - 512 MB	8 KB
512 MB - 1 GB	16 KB
1 GB - 2 GB	32 KB

These examples illustrate how partition size relates to data storage efficiency.

- If you create a 2.14 GB partition (2047 binary MB), each disk cluster is 32 KB. (In binary notation, KB equals 1 024 bytes.) A 1 KB file uses one cluster (32 KB) of disk space.
- If the partition size is 1.00 GB (977 binary MB), the cluster size is 16 KB. A 1 KB file uses one cluster (16 KB) of disk space.

A normal mix of application and data files can include thousands of different-sized files. If you replace your disk drive with a larger capacity drive, normally you will create a larger primary partition or logical drive on the new device. When you copy files from a smaller to a larger partition, the same files might take surprisingly more disk space. The increase in disk space for the same files is caused by the increase in cluster size.

Preparing the primary drive for DOS or Windows 3.x

If you are installing the drive that will contain your operating system (the primary drive), find your operating system installation diskettes and insert the first operating system installation diskette into the diskette drive (or insert the operating system installation CD if your operating system is installed from the CD-ROM drive). Restart your computer. The operating system screens lead you through partitioning and formatting the drive.

After creating the primary partition, you can use the remaining disk space for an extended partition. Follow the instructions on the screen to create one or more logical drives within the extended partition.

Preparing a secondary drive for DOS or Windows 3.x

A secondary drive is any hard disk drive that does not contain the active primary partition (the partition that contains your operating system). Normally you allocate all of the disk space on a secondary drive to an extended partition and then create logical drives in the extended partition. For more information about creating partitions see the documentation that comes with your operating system.

The following example uses the FDISK and FORMAT commands to partition and format an extended partition on a secondary hard disk drive.

1. At the DOS prompt, type `fdisk` and press Enter.

2. FDISK displays the current fixed-disk drive message, containing the current fixed-disk drive number, above the FDISK menu. The fixed-disk drive number is not associated with the logical drive letters assigned by FDISK. Check the current fixed disk drive number to be sure that you partition the correct hard disk drive.

   The default current fixed disk drive is the fixed disk drive containing the active primary partition (drive C). To change the fixed disk drive number for the secondary drive:

   a. From the FDISK menu, select **Change current fixed disk**.
   b. From the drive list, select the new drive number.
   c. Return to the FDISK menu.

3. Select **Create DOS partition or Logical DOS Drive** and press Enter.
4. Select **Create Extended DOS Partition** and press Enter. The default size is the remaining space on the drive. You must accept the default size to use the full capacity of your drive.
5. The Create Logical DOS Drive(s) in the Extended DOS Partition screen displays. Follow the instructions on the screen to create one or more logical drives within the extended partition.
6. When you are finished, press ESC to return from the FDISK menu.
7. When you are prompted, restart your computer and format your logical drives.
8. To format a logical drive, type `format x:` (where *x* is the logical drive letter assigned by FDISK) at the DOS prompt and press Enter.

Copying files to your new primary drive

> **Note:** This procedure is included as an alternate method for transferring files from one hard disk drive to another. If you are not sure about your operating system configuration parameters or about applications or files that might be open, do not use this procedure.

If you are replacing your primary drive, you can install your operating system and other applications on your new primary drive. As an alternative, you can use the following procedure to copy your installed operating system and applications from your old primary drive to your new primary drive.

1. Leave your existing primary hard disk drive installed and install your new drive as a second drive.
2. Use FDISK to create a primary partition on the new drive. You can have only one active primary partition on the computer so this will be an inactive primary partition.
3. Exit FDISK and restart your computer. FDISK assigns a drive letter to the inactive partition. Use the FORMAT command to format the new drive.
4. Use XCOPY to copy directories and files from the C drive to your inactive primary partition on the new drive. For information about XCOPY options, see

the documentation that comes with your operating system. Before you run XCOPY, close all other applications including Windows. If an active application locks data files, the files might not be copied.

5. Open FDISK and display the current drive partitioning information. Select the current startup partition drive number and make this partition inactive (you no longer can restart from this partition).

   Select the new drive number and make its primary partition active.

6. Press ESC to exit FDISK. Restart your computer when prompted.

7. Turn off your computer and disconnect the power cord. Open up the computer and set the SCSI ID for the new drive to the ID your SCSI adapter requires for the primary drive, for example, SCSI ID 0 or 6. To avoid duplicate SCSI IDs for the two drives, remove the original startup drive or change the SCSI ID of the original drive.

8. Close the computer, reconnect the power cord, and restart the computer. The computer starts from the primary partition on the new drive.

If files are not copied correctly from your old drive, your computer might not start correctly. If this happens you must reinstall your operating system on the new drive. For more information, see the documentation that comes with your operating system.

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Part 2: Appendixes

This section contains performance data, problem solving, help and service, notices, and trademark information.

Appendix A. Performance data

For a SCSI device chain with both Ultra2 or Ultra160 devices and pre-Ultra2 devices, refer to the following table for maximum achievable data transfer rates.

From/to adapter type	To/from device type	Other devices on SCSI device chain	Maximum achievable data rate
Ultra160	Ultra160	Ultra160	160 MBps
Ultra160	Ultra160	Ultra2	160 MBps
Ultra160	Ultra160	pre-Ultra2	40 MBps
Ultra160	Ultra2	Ultra160	80 MBps
Ultra2	Ultra160	Ultra160	80 MBps
pre-Ultra2	Ultra160	Ultra160	40 MBps

The previous table provides only maximum data transfer rates. Additional factors can affect actual data transfer rates. For example, the average data transfer speed is affected by the number of hard disk drives on the device chain, the number of hard disk drives that are currently being accessed, and whether the drives are accessing small random or large continuous data files.

Appendix B. Solving problems

Using the information in this section, you might be able to solve the problem yourself or gather information that you can pass to the service representative when you make your call.

Your computer or hard disk drive does not operate correctly.

- Check the drive to ensure that all power and signal cables are securely attached.
- Check the SCSI-ID jumper setting. No two SCSI devices can have the same SCSI ID. This includes the SCSI adapter.
- Be sure that the last device or cable terminator terminates the SCSI cable. There must be a terminator or a terminating device at the end of the SCSI cable. You must terminate both internal and external SCSI cables. Remove any terminators on devices that are not at the end of the cable.
- If you are installing the drive in an IBM server, be sure that Auto-Start is not active.

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- Turn off all attached devices before turning off the computer. Unplug the computer power cord. Remove the drive. Check for bent or misaligned pins. If there are no problems, reinstall the drive.

Your computer does not configure the hard disk drive correctly.

- Most configuration problems are caused by incorrect termination or incorrect SCSI ID configuration. If multiple SCSI devices are attached, disconnect all other SCSI devices on the chain. Assign the highest priority SCSI ID available (6) to the drive and terminate the drive. Try to detect the drive using your SCSI adapter utility program.
- If you have just installed a SCSI adapter and you are now installing the SCSI hard disk drive, your SCSI adapter must be correctly configured before you can activate the drive. To configure the adapter, you might need to know the available I/O addresses, IRQs, and ROM addresses. If you are unable to configure your adapter, you will not be able to use your SCSI device. If you need more information about configuring your adapter, see the documentation that came with your computer or SCSI adapter.
- Termination power must be applied to the SCSI device chain. This is not the same as signal termination. If your adapter does not supply termination power, power must be supplied by a device on the SCSI device chain. Multiple devices can supply termination power to the SCSI device chain, but only one device can terminate the chain.
- Use the following cable length guidelines for attaching your new SCSI drive to an existing Ultra SCSI device chain.
  - SCSI-2 and Ultra SCSI device cables cannot exceed 3 m (9 ft 10 in).
  - If more than four devices are on the SCSI device chain, the maximum cable length cannot exceed 1.5 m (4 ft 11 in).
  - The total length of cable for a chain comprised of only Ultra2/Ultra160 SCSI devices must be less than or equal to 12 m (39 ft 4 in).
- Older SCSI devices might not support synchronous data transfer. If you have an older SCSI drive, CD-ROM drive, or tape drive in your computer, erratic operation or other problems might occur during asynchronous data transfer. If problems occur, remove the other drives on the cable and retry the operation. If this does not solve the problem, try using your SCSI adapter utility to select asynchronous data transfer for use with your SCSI adapter.
- If you are attaching an UltraSCSI device in an external enclosure and the faster data transfer rate does not work, use your Ultra SCSI adapter utility to disable the faster data transfer rate.
- Check for a jumper in the Auto-Start position. When you install a jumper on the Auto-Start pins, the hard disk drive motor starts when the computer is turned on. When the auto-start position is open the drive must receive a start command from the SCSI adapter before it can spinup. Some computers expect the drive to be spinning and do not wait for a command from the SCSI

adapter. Also, you might have to select additional settings on your SCSI adapter.

If you need more information, see the documentation that comes with your operating system and SCSI adapter.

Appendix C. Help and service information

See Appendix B, “Solving problems” on page 2-1 before requesting help or service.

This section contains information on how to obtain online and telephone technical support.

Online technical support

Online technical support is available during the life of your product. Online assistance can be obtained through the Personal Computing Support Web site and the IBM Automated Fax System.

Online technical support	
IBM Personal Computing Support Web Site	http://www.ibm.com/pc/support
IBM Automated Fax System	1-800-426-3395 (U.S. and Canada)

During the warranty period, assistance for replacement or exchange of defective components is available. In addition, if your IBM option is installed in an IBM computer, you might be entitled to service at your location. Your technical support representative can help you determine the best alternative.

Telephone technical support

Marketing, installation, and configuration support through the HelpCenter will be withdrawn or made available for a fee, at IBM’s discretion, 90 days after the option has been withdrawn from marketing. Additional support offerings, including step-by-step installation assistance, are available for a nominal fee.

To assist the technical support representative, have available as much of the following information as possible:

1. Option name
2. Option number
3. Proof of purchase
4. Computer manufacturer, model, serial number (if IBM), and manual
5. Exact wording of the error message (if any)
6. Description of the problem
7. Hardware and software configuration information for your system

If possible, be at your computer. Your technical support representative might want to walk you through the problem during the call.

For the support telephone number and support hours by country, refer to the following table or to the enclosed technical support insert. If the number is not provided, contact your IBM reseller or IBM marketing representative. Response time may vary depending on the number and nature of the calls received.

Support 24 hours a day, 7 days a week	
Canada	1-800-565-3344
U.S.A./Puerto Rico	1-800-772-2227

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Appendix D. Notices and trademarks

This section contains notices and trademark information.

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