

8.4 GB Capacity Barrier

3.5-inch EIDE Hard Drives

Some system BIOSs and operating systems have limitations associated with large capacity hard drives. There are several PC components that have an EIDE hard drive capacity limitation at approximately 8.4 GB. These limitations apply to any hard drive that reports an EIDE capacity of 16320 cylinders x 16 heads x 63 sectors per track or larger. The following is a discussion of how these limitations affect the system BIOS Interrupt 13 functions, the operation of EIDE hard drives, and operating systems.

System BIOS Interrupt 13 Functions

Interrupt 13 (INT 13) Functions:

INT 13 Function 8 is the traditional method used by the system BIOS to access hard drives using cylinders, heads, and sectors per track (CHS). Identify Drive words 1, 3, and 6 contain these values. The maximum values the BIOS can report (1024 cylinders 256 heads, and 63 sectors) have been exceeded by the 8.4 GB and larger hard drive capacities.

Because some operating systems do not function properly with 256 heads, all system BIOSs report a maximum number of 255 heads. There are times when a hard drive is large enough that INT 13 Function 8 could report 1024 cylinders. However, it is common for only 1023 cylinders to be reported. The remaining diagnostic cylinder is not made accessible through INT 13 function calls.

Extended INT 13 Functions:

To utilize the full capacity of hard drives larger than 8.4 GB, the system BIOS must use extended INT 13 functions. To recognize the full capacity of hard drives larger than 8.4 GB, extended INT 13 functions use Identify Drive words 60 and 61 rather than words 1, 3, and 6.

Many system BIOSs do not support extended INT 13 functions. DOS 6.22 and earlier versions do not recognize or utilize these extended functions even if they exist in the BIOS. Windows 95, Windows 98, and boot disks created with Windows 95, are capable of utilizing these functions and recognizing hard drives larger than 8.4 GB.

WDTBLCHK Version 2.00 and later can be used to determine if these functions are present.

EIDE Hard Drives

System BIOSs and operating systems check the capacity of EIDE hard drives by issuing an Identify Drive command. The hard drive reports the capacity in two ways:

1. The number of cylinders, heads, and sectors per track (in words 1, 3, and 6).
2. The total number of addressable sectors (in words 60 and 61).

Most EIDE 8.4 GB hard drives report their capacity as 16383 cylinders, 16 heads, and 63 sectors per track in Identify Drive words 1, 3, and 6. This results in a total number of addressable sectors of 16,514,064 (8455 MB). 8.4 GB is the largest capacity that can be reported with words 1, 3, and 6 because the maximum value these words can hold are 16383x16x63.

To determine the true capacity of hard drives larger than 8.4 GB, the system BIOS must access Identify Drive words 60 and 61 and use the total addressable sectors.

System BIOS Limitations at 8.4 GB

Many BIOSs do not properly support 8.4 GB and larger hard drives. We recommend using EZ-Drive 9.06W or later. EZ-Drive 9.06W or later supports extended INT 13 functions which allows the BIOS to access the full capacity of 8.4 GB and larger hard drives. EZ-Drive 9.06W can be downloaded from Western Digital's web site at www.westerdigital.com

Some of the BIOS issues that may be encountered with 8.4 GB or larger hard drives are:

1. **Reporting 0 Heads in INT 13 Function 8.**
Some BIOSs attempt to use translated geometry but incorrectly report 0 heads in INT 13 Function 8 instead of 255 heads. If Fdisk is run on these systems, it initially appears to function normally. However, a corrupted partition is created which incorrectly reports the drive has 0 heads. DOS hangs, even when booted from a floppy, as soon as it detects this partition.

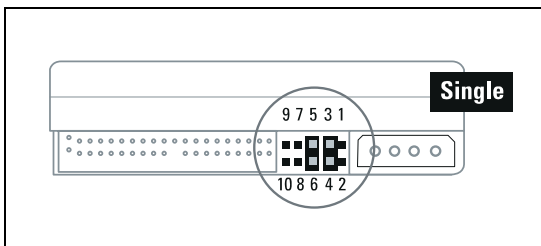
To correct this issue:

- Boot to a bootable non-DOS based floppy. EZ-Drive can be used for this purpose.
- Boot to the EZ-Drive diskette and set up the drive using EZ-Drive. This repartitions and formats the drive correctly so that the system can boot properly.

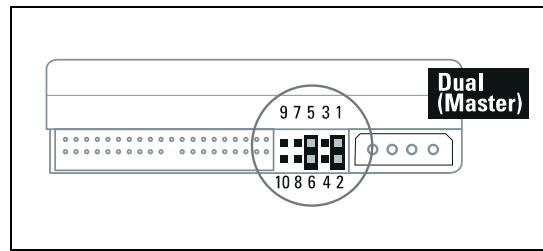
2. **Failure to Translate or Reporting Much Lower Capacities.** Some BIOSs will not translate an 8.4 GB hard drive, or will report a capacity significantly less than 8.4 GB. In some cases, an 8.4 GB or larger drive causes INT 13 Function 8 to revert back to what appears to be a 528 MB or less limitation. The solution is to either obtain a BIOS upgrade if possible, or use EZ-Drive 9.06W.

3. **Hang During Boot.** Some systems hang after power on when auto-detecting an 8.4 GB hard drive. This hang does not disappear until a less than 8.4 GB drive type is selected in CMOS, making it impossible to utilize the full capacity of the hard drive. The solution is to select a User Defined type that is less than 8.4 GB, and use EZ-Drive 9.06W to set up the hard drive.

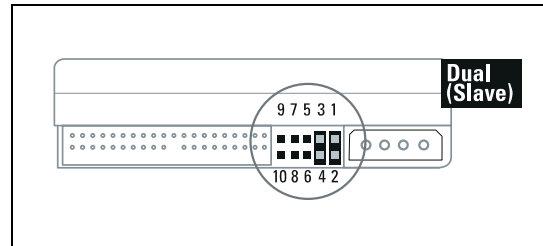
4. **POST Error During Boot.** In some systems with proprietary BIOSs you may encounter errors during POST or a failure to boot properly. If this happens it may be necessary to use the Alternate Jumper Settings shown below and set up the hard drive using EZ-Drive. The Alternate Jumper Settings are used to force the drive to report 4092 cylinders in Identify Drive word 1, but still report the true capacity in words 60 and 61. This allows EZ-Drive and the extended INT 13 functions to recognize the true capacity of the hard drive.



Single Drive Alternate Jumper Settings



Dual (Master) Drive Alternate Jumper Settings



Dual (Slave) Drive Alternate Jumper Settings

5. **240 Head BIOS Translation.** Many BIOSs report a maximum of 240 heads in INT 13 Function 8, giving a limitation of 7.9 GB (1024x240x63). Some of these BIOSs still support extended INT 13 functions. Windows 95 and Windows 98, which utilize the extended INT 13 functions, recognize the full 8.4 GB or larger capacity. DOS 6.x and Windows 3.x are limited to 7.9 GB because they do not utilize the extended INT 13 functions.

Operating System Limitations at 8.4 GB

1. **DOS 6.x and Windows 3.x.** These operating systems do not support extended INT 13 functions so they are dependent on the INT 13 Function 8 BIOS limitation of the system.

DOS is limited to a maximum of 1024 cylinders, 255 heads, and 63 sectors per track (16,450,560 addressable sectors or 8423 MB). Therefore, the maximum values DOS can recognize in Identify Drive words 1, 3, and 6 are 16320x16x63 (8423 MB). DOS cannot utilize the full capacity of hard drives larger than 8.4 GB.

2. **Windows 95 & Windows 98.** Windows 95 and Windows 98 support extended INT 13 functions, and therefore support 8.4 GB and larger hard drives. However, if the system BIOS does not support extended INT 13 functions, then Windows 95 and Windows 98 are limited by the system BIOS's barrier and cannot support the full capacity of 8.4 GB and larger hard drives.

To ensure that Windows 95 and Windows 98 recognize the full capacity of 8.4 GB and larger hard drives, the system BIOS must support extended INT 13 functions.

3. **Windows NT 4.0.** Windows NT 4.0 recognizes the full capacity of hard drives up to the 8.4 GB limit in Identify Drive words 1, 3, and 6. Service Pack 3 is required to recognize hard drives larger than 8.4 GB. Without Service Pack 3, hard drives larger than 8.4 GB are treated as the capacity shown in Identify Drive words 1, 3, and 6 regardless of what is reported in words 60 and 61 (8.4 GB max.). Windows NT 4.0 Service Pack 3 can be obtained from the Microsoft web site at: support.microsoft.com/support/ntserver/content/servicepacks/where.asp

The first partition in Windows NT 4.0 is limited to 4 GB. During the initial setup, it appears that the full capacity of the hard drive is not recognized. After installing Windows NT, use the Disk Administrator utility that comes with Windows NT to create additional partitions to utilize the full capacity of the 8.4 GB hard drive. Windows NT 4.0 does not require extended INT 13 functions to recognize the full capacity of the hard drive. Windows NT operates the same regardless of whether the extended INT 13 functions are present.

4. **OS/2 Warp 4.0.** As of the date of this document, OS/2 Warp cannot be installed properly with 8.4 GB and larger hard drives. IBM is currently working on a patch to correct this.
5. **Novell Netware 4.11.** Novell Netware 4.11 recognizes the full capacity of hard drives up to the 8.4 GB limit in Identify Drive words 1, 3, and 6. Since Novell does not check Identify Drive words 60 and 61, hard drives larger than

8.4 GB are treated as the capacity reported in words 1, 3, and 6 (8.4 GB maximum).

Novell Netware does not use extended INT 13 functions, so it cannot support larger than 8.4 GB hard drives.

Conclusion

The limitations of your system BIOS and your operating system combined determine your overall system limitation. For example, if your operating system recognizes extended BIOS functions, but your system BIOS has a 2.1 GB hard drive barrier, you are limited to your system BIOS's 2.1 GB hard drive barrier. Conversely, if your operating system does not recognize extended BIOS functions, but your system BIOS supports 8.4 GB hard drives, you are limited to your operating system's capability. Your system limitation is based on the lowest functioning barrier.

To utilize the full capacity of 8.4 GB and larger hard drives, your system BIOS and operating system must support extended INT 13 functions.

Since it is difficult to determine if your system BIOS supports 8.4 GB or larger hard drives, we recommend using EZ-Drive 9.06W or later. EZ-Drive 9.06W or later can determine whether or not your system BIOS properly supports the full capacity of your hard drive. If it does not, EZ-Drive installs EZ-BIOS on the boot sector of the hard drive to support the full capacity of your 8.4 GB or larger hard drive. If your system BIOS supports your hard drive, EZ-Drive does not install EZ-BIOS. EZ-Drive software can be downloaded from Western Digital's web site at: www.westerndigital.com.

For more details on proper BIOS implementation of large drives, refer to the "*BIOS Enhanced Disk Drive Specification*" available on the Phoenix Technologies Web site at: <http://www.phoenix.com/techs/specs.html>

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