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Compact Flash  
in 3.5" Adaptor

## Preparing an IDE Device Using a PC's FDISK

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### Preparing an IDE Device Using a PC's FDISK

#### Background:

As everyone is aware, the present Z-217 Hard Drive (Winchester) Controller has served the Z-100 community since nearly the birth of the Z-100 in the early 1980's. However, the MFM hard drives are becoming increasingly difficult to obtain and those first models are wearing out. These early five and ten megabyte drives are also being strained to their limits by the increasing data requirements of today's operating system and applications.

The "Z-100 LifeLine" IDE Controller Card permits us to use the more common IDE drives presently being manufactured with capacities that strain the imagination when compared to the 40 megabyte drives of yesterday.

But, even better, the new Compact Flash IDE devices, such as the one pictured, allows even more flexibility, especially if used in conjunction with a PC-clone.

The Compact Flash (CF) permits us to retain the use of our IDE device in a PC, while providing us with a high capacity means of transferring data between the PC world and our Z-100's.

This simply requires placing the information on the drive in a format recognized by both systems and assigning one or more partitions on the CF IDE device for use on the Z-100. And since we have complete control over all aspects of doing this from a Z-100's perspective, it is possible to leave the primary partition on the CF card that would contain the PC's Operating System (Windows) and be completely undisturbed by operation in the Z-100.

In short, this means that we could use a properly prepared system drive from a PC, place it in the Z-100 to work on or transfer data files, then return with the information for processing on the PC.

#### Z-100 Compatible IDE Devices



IDE Drives

## IDE Drives

There are three main types or categories of IDE drives:

- Non-intelligent ATA-IDE drives
- Intelligent ATA-IDE drives
- Intelligent Zone Recorded ATA-IDE drives

The non-intelligent IDE drives supported just 8 total commands, with few other options, and used the standard ST-506/412 or ESDI controllers bolted directly to the drive.

The intelligent varieties had several more capabilities, including enhanced commands and sector-translation support. Then things got even more complicated as drive capacities grew in size and PC-clones moved on to much newer architectures.

We want to concentrate on the early IDE drives for several reasons:

- Not all IDE drives will work.
- Drives sizes become unmanageable in our Z-100; not for the reasons you may think.
- Drive dynamics exceed those acceptable to our IDE Controller.

So, limit your interest in IDE drives to those from early PC-clones such as Windows 95 & 98 computers.

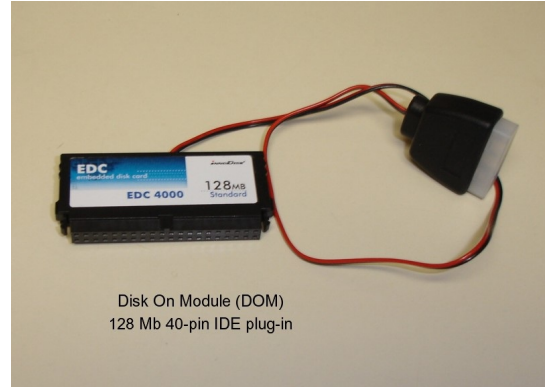


## Compact Flash (CF) Cards

The Compact Flash (CF) is a flash memory mass storage device used mainly in portable electronic devices. The format was specified and the devices were first manufactured by SanDisk in 1994. Compact Flash became one of the most successful of the early memory card formats, surpassing Miniature Card and SmartMedia.

The CF Memory Card seems to be ideal in the smaller sizes. Simple in design, small in physical size, and removable, all it required was a CF to IDE adapter. While most adapters were available as a simple, small circuit board that plugs into a 40-pin IDE connector, some, like in the opening photograph, came with a small 3.5" drive mounting. Perfect!

**Note:** Some newer PC-clones now come with media interfaces that allow the use of all types of memory devices (e.g., CF cards, SD cards, etc.). These simply read from and write to these media devices and do **not** function in the same manner as an actual drive. Please use a 40-pin, CF to IDE or similar adapter (See first photo) to properly simulate an IDE drive.



## IDE Disk On Module (DOM)

I had also found a Disk On Module (DOM) that could plug directly into the 40-pin connector of the LifeLine IDE Controller. It had several advantages over anything else.

- No special cabling was required
- No special mounting hardware was required
- Sizes offered were perfect for the Z-100

Just plug it into the 40-pin connector and plug in the power cord. One major disadvantage was that the normal IDE controller connectors were directed upward, which meant that with the DOM installed, the computer cover on the Z-110, Low-profile computer could not be installed. But it was perfect for the Z-120, "All-in-one".

**Note:** There is also a 44-pin variety, which includes integral power leads. As our IDE connector is 40 pins, these will not work.

**Note:** The DOM that I tried was a bit flaky, but this may have just been my particular unit. I would like to hear from others regarding the DOM's performance.

## Preparing the IDE Device

There were to be several means of preparing an IDE hard drive or other device for use in the Z-100. Unfortunately, only one was developed.

This article guides you through the procedures for preparing an IDE Hard Drive for use in the Z-100 using a PC's FDISK program.

But, before we start, let's discuss the reasons for the various size limitations that will be imposed on the hard drive.

The information presented in the following is based upon various articles in the Microsoft Knowledge Base found at microsoft.com.

#### **Operational Limitations:**

There are numerous operational limits imposed upon the operation of an IDE drive in our Z-100. In brief, these are:

\* The LifeLine IDE Controller Card requires the use of a new monitor ROM, MTR-ROM v4.3 or later.

\* Z-DOS v4 is required and is presently the ONLY operating system that would recognize the new hardware.

\* Each Z-100 accessible partition will be limited to 2 Gb in size (imposed by the maximum 16-bit FAT that would be usable by the Z-100).

\* The PC Operating System could still use a 16-bit FAT (e.g., Windows 9x) or 32-bit FAT (e.g., Windows 98SE).

\* The maximum drive size that could be used with the Z-100 is 7.8 Gb unless interrupt 13 handling is available, then it is 137 Gb, as limited by the 28-bit LBA addressing standards before ATA/ATAPI-6.

\* Newer drives, larger than 137 Gb use the new 48-bit LBA addressing standard of ATA/ATAPI-6. These will NOT be supported by the Z-100.

#### **The FAT16 File System**

Microsoft MS-DOS versions 4.0 and later allow FDISK to partition hard disks up to 4 Gb in size. However, the MS-DOS file allocation table (FAT) file system can support only 2 Gb per partition. Therefore, a hard disk greater than 2 Gb must be broken down into multiple partitions, each of which does not exceed 2 Gb.

**Note:** Windows 95 OEM Service Release version 2 and later support drives larger than 2 Gb using the FAT32 file system. See the section, **The FAT32 File System**, later in this article.

The 2 Gb partition limit is imposed by the maximum number of clusters and the largest cluster size supported by the FAT file system.

The FAT file system is limited to 65,525 clusters. The size of a cluster must be a power of 2 and less than 65,536 bytes -- this results in a maximum cluster size of 32,768 bytes (32K). Multiplying the max number of clusters (65,525) by the max cluster size (32,768) equals 2 Gb.

Note that the hard disk drive must be supported by the computer's ROM BIOS, which has a 1024 cylinder limitation, in order for FDISK to partition the hard disk.

Because 32K per cluster can waste valuable hard disk space, the FAT file system is not always the best hard disk management scheme. Later Windows Operating Systems use other schemes.

#### **FAT Type and Cluster Size Depend on Logical Drive Size**

MS-DOS allocates disk space for files in units of one or more sectors; these units are called "clusters" or "allocation units." On any MS-DOS disk, a 1-byte file is allocated 1 cluster of disk space, wasting the unused area of the cluster. A file that is 3.2 clusters large is given 4 clusters. Overall, a smaller cluster size means less waste.

The cluster size for a drive is decided by **FORMAT**, depending on the size of the logical drive (see **Table 1**, below). "Logical drive" refers to an MS-DOS volume accessed by a drive letter (A:, B:, C:, D:, and so forth).

The cluster size of a floppy drive can not be changed. But, hard disk users may want to consider cluster size when choosing how to partition their drive(s).

The cluster size of a hard drive can be changed only by changing the size of the logical drive, which is done by repartitioning the hard drive.

CHKDSK displays the allocation unit size for a logical drive. FDISK's option 4 displays the size(s) of logical drives on the hard drive(s).

MS-DOS determines the FAT size based on the number of clusters. If there are 4086 or fewer clusters, a 12-bit FAT (FAT12) is used. If there are 4087 or more clusters, a 16-bit FAT (FAT16) is used. The Z-100 will recognize both 12 and 16-bit FATs.

#### **Hard Disk Limited to 8 Gb Partition**

When you try to partition a drive that is larger than 8 gigabytes (Gb) in size, the maximum partition size may be 8 Gb.

This behavior can occur if the hard disk controller does not fully support the interrupt 13 extensions. This information applies to both IDE and SCSI hard disk drives.

In order for a hard disk that is larger than 8 Gb to be fully addressed, it must support interrupt 13 extensions. Our IO.SYS tests for the presence of interrupt 13 extensions. If interrupt 13 extensions are not detected, the default CHS LBA limit of 7.9 Gb is used.

**Table 1** shows a table of logical drive sizes, FAT (File Allocation Table) types, and cluster sizes.

Table 1.

Table of logical drive sizes, File Allocation Table types, and cluster sizes

|                | Drive Size<br>(logical volume) | FAT Type | Sectors<br>Per Cluster | Cluster<br>Size |
|----------------|--------------------------------|----------|------------------------|-----------------|
| (Floppy Disks) | 360K                           | 12-bit   | 2                      | 1K              |
|                | 720K                           | 12-bit   | 2                      | 1K              |
|                | 1.2 MB                         | 12-bit   | 1                      | 512 bytes       |
|                | 1.44 MB                        | 12-bit   | 1                      | 512 bytes       |
|                | 2.88 MB                        | 12-bit   | 2                      | 1K              |
| (Hard Disks)   | 0 MB - 15 MB                   | 12-bit   | 8                      | 4K              |
|                | 16 MB - 127 MB                 | 16-bit   | 4                      | 2K              |
|                | 128 MB - 255 MB                | 16-bit   | 8                      | 4K              |
|                | 256 MB - 511 MB                | 16-bit   | 16                     | 8K              |
|                | 512 MB - 1023 MB               | 16-bit   | 32                     | 16K             |
|                | 1024 MB - 2047 MB              | 16-bit   | 64                     | 32K             |

NOTE: Sectors are 512 bytes in size, except on some RAM drives.

NOTE: Some manufacturers modified their versions of MS-DOS to support other sector and/or cluster sizes.

NOTE: DoubleSpace-compressed drives appear to have 8K clusters, but internally vary the sectors-per-cluster as necessary (this information is recorded in the MDFAT). For example, a 10K file which compresses by a factor of 2:1 actually uses 5K, or 10 sectors, of drive space.

#### IDE Device Practical Size Limits?

So, as we can see from the above, the LLIDE Controller can handle most media sizes, but a usefulness factor comes into play when the media is used in the Z-100.

In a computer environment where hard drives began with 5 or 10Mb capacity, is there too much capacity when you exceed 100 times that? Do you need more than that?

Further, do you want to wait around while handling huge files at a whopping 5 to 10 MHz? Remember how long it took to do memory tests on a 10 Mb hard drive?

However, let me show you some numbers from a recent (August 2020) experience. I had to copy the entire "Z-100 LifeLine" Software Library from one 512Mb CF card to another. My Z-100 was running with a V20 CPU at 8.00 MHz. I used the XCOPY /S/V command to copy all of drive P: to T:. It took 72 minutes to copy (and verify) about 262 Mb in 16,207 files. Try that on the latest MFM hard drives!

But there is another limit that you may not have thought of. Some of our software, Peachtext 5000, for one, can not recognize partitions greater than 32 Mb (due to limits on addressing capability). So, if we need to have a few 32 Mb partitions for these applications, we could be limited with how many partitions we can use at a time (we only have about 20 drive letters available to assign at any one time).

But, even worse, with so many partitions, how would we manage keeping track of what files are listed where? We would need a partition lister that would do for partitions what DIR or ZDIR do for directories and files.

So, I try to encourage those looking for suitable IDE drives or devices (such as CF cards) to limit their capacity to less than 1 or possibly 2 gigabytes. I like the 128, 256, and 512Mb Compact Flash cards.

**Note: OEMPCWorld.com** is a great, reasonably priced source of generic cards, such as their GigaRam brand. So far, these have worked well for me.

In fact, I find the 512 Mb units to work very nicely. You can create two or three 32 Mb partitions and two larger 200+ Mb partitions for the Z-DOS operating system and data/backup files.

If you intend to use a CF card with a PC-clone, then the larger devices would make more sense, leaving a huge partition for use on the PC.

#### MS-DOS Partitioning Summary

##### Notes:

\* MS-DOS began supporting hard disks in version 2.0.

\* A hard disk's master boot record (MBR) is located in the first sector of the disk (cylinder 0, side 0, sector 1).

\* The partition table is located at offset 01BE, containing up to four 16-byte entries.

\* The fourth byte of each partition table entry is used to mark the partition type.

\* **Table 2** shows the MS-DOS partition types.

Table 2.

| Partition Type | FDISK Reports | Size           | FAT Type | Starting in version |
|----------------|---------------|----------------|----------|---------------------|
| 01             | PRI DOS       | 0-15 MB        | 12-Bit   | MS-DOS 2.0 (a)      |
| 04             | PRI DOS       | 16-32 MB       | 16-Bit   | MS-DOS 3.0          |
| 05             | EXT DOS       | 0-2 GB (b)     | n/a      | MS-DOS 3.3          |
| 06             | PRI DOS       | 32 MB-2 GB (b) | 16-bit   | MS-DOS 4.0          |
| 0E             | PRI DOS       | 32 MB-2 GB     | 16-bit   | Windows 95          |
| 0F             | EXT DOS       | 0-2 GB         | n/a      | Windows 95          |
| 0B             | PRI DOS       | 512 MB - 2 TB  | 32-bit   | OSR2                |
| 0C             | EXT DOS       | 512 MB - 2 TB  | 32-bit   | OSR2                |

- (a) 15-MB size limitation extended in version 3.0.
- (b) 2 GB (gigabytes) includes a limit of 1024 cylinders per drive imposed by the standard AT ROM BIOS interrupt 13h protocol.
- (c) Types 0E, 0F, and 0C require extended Interrupt 13h support.

**MS-DOS 2.x** supported one type 01 partition of up to 15 megabytes (Mb) in size, which uses a 12-bit file allocation table (FAT). FDISK created only one MS-DOS partition per drive.

**MS-DOS 3.0** supported partitions larger than 15 Mb using a 16-bit FAT, which allowed a smaller cluster size and more efficient disk usage. As a result, MS-DOS 2.x hard disks larger than 15 Mb are incompatible with later versions of MS-DOS. FDISK created only one MS-DOS partition per drive.

**MS-DOS 3.3** introduced support for more than one logical drive per hard disk. Logical drives were treated as completely separate disks under MS-DOS, even though they may occupy the same physical hard disk.

This was supported by using nonbootable MS-DOS partitions known as extended MS-DOS partitions. FDISK reported these as EXT DOS; other MS-DOS partitions were reported as PRI DOS (for primary MS-DOS). Each primary MS-DOS partition was a logical drive, and extended MS-DOS partitions contained from 1 to 23 logical drives (MS-DOS supported drive letters up to Z).

Logical drives in extended MS-DOS partitions have the same FAT type as a primary MS-DOS partition of the same size.

**Note:** Other FDISK programs in the PC world use other partition schemes. See the documentation on your particular FDISK.

Only one PRI DOS partition and one EXT DOS partition was allowed per drive. On computers with two physical hard disks, a PRI DOS partition was required on the first physical disk, but not required on the second physical disk. MS-DOS did not support more than two physical disks.

**MS-DOS versions 4.0 and later** supported logical drives larger than 32 Mb. Full usage of these logical drives required the MS-DOS program SHARE.EXE to be loaded in MS-DOS 4.0.

**MS-DOS versions 5.0 and later** supported up to eight physical hard disks. SHARE.EXE was not required for full large-drive support; this support was included in the MS-DOS kernel.

The same partitioning strategy was used as with version 4.x, including FDISK's inability to create more than one primary MS-DOS partition on a physical disk. However, because some original equipment manufacturer (OEM) partitioning software allowed you to create more than one primary MS-DOS partition, MS-DOS versions 5.0 and later had kernel support for up to four primary MS-DOS partitions.

This made it easier to upgrade from previous versions of OEM-modified MS-DOS. FDISK still created only one PRI DOS partition on a physical disk.

**Note:** Many manufacturers changed their versions of MS-DOS to support more than one primary MS-DOS partition, larger type 04 partitions, and new partition types.

**Windows 95** supported two new partition types (0E and 0F) to support the Logical Block Addressing (LBA) Interrupt 13h extensions.

**Note:** Type 0E is the same partition type as 06, and 0F is the same as 05. However, the LBA Interrupt 13h extension's read/write functions should be used to read from or write to the drive instead of the normal Cylinder/Head /SectorPerTrack (CHS) Interrupt 13h functions because the hard disk has more than 1024 cylinders and/or more than 16,711,680 sectors.

**Note:** Earlier versions of FDISK recognize these Windows 95 partitions as NON-DOS partitions.

**Windows 95 OEM Service Release 2 (OSR2), Windows 98, Windows 98 Second Edition, and Windows Millennium Edition (Me)** support the FAT16 and FAT32 file systems. They use two new partition types (0B and 0C) to support the FAT32 file system. See the section, **The FAT32 File System**, at the end of this article.

**Microsoft Windows NT, Windows 2000, and Windows XP:** Because 32K per cluster can waste valuable hard disk space, the FAT file system is not always the best hard disk management scheme. While these Windows Systems default to the FAT32 file system, they could use the New Technology File System (NTFS), which used a different file /cluster scheme. The systems had to use one filing system or the other. Once you converted a FAT volume to NTFS, it was not reversible - a one-way conversion.

An NTFS volume had a minimum size limit of 10 Mb, due to the additional overhead.

The maximum supported volume size was 2 Tb, and there was no limit on the file size.

**Microsoft OS/2 version 1.2** uses another new File System, called the High Performance File System (HPFS). The HPFS (also supported by Windows NT) was developed by Microsoft for OS/2, mostly to support the LAN Manager file server. It provided better performance than FATs on larger disk volumes and supported long file names.

While OS/2 will work with a FAT file system, its relationship with the older FAT systems gets complicated and is beyond the scope of this article.

**VFAT** is one more file system worthy of mention here. Supported only by Windows 9x and Windows NT, it uses the same directory structure, format, and partition type as an ordinary FAT, but then VFAT allocates additional directory blocks to hold longer file names.

### The FAT32 File System

Windows 95 OSR2, Windows 98, and Windows Me include an updated version of the FAT file system called FAT32, which supports drives up to 2 Tb in size. FAT32 uses smaller clusters (that is, 4 KB clusters for drives up to 8 Gb in size), resulting in 10 to 15 percent more efficient use of disk space relative to large FAT or FAT16 drives.

FAT32 can relocate the root folder and use the backup copy of the file allocation table instead of the default copy. In addition, the boot record on FAT32 drives is expanded to include a backup copy of critical data structures. The root folder on a FAT32 drive is an ordinary cluster chain, so it can be located anywhere on the drive. The previous limitations on the number of root folder entries no longer exist.

MS-DOS, the original version of Windows 95, and Windows NT 4.0 do not recognize FAT32 partitions, and are unable to boot from a FAT32 volume. Also, FAT32 volumes cannot be accessed properly if the computer is started by using another operating system (e.g., a Windows 95 or MS-DOS boot disk). Microsoft Windows 2000 only supports FAT32 partitions up to a size of 32 Gb.

While a FAT32 conversion tool can convert an existing drive to the FAT32 file system, Windows does not include a utility for converting a

drive back to FAT16 once you have converted it to FAT32.

Most disk compression software, including Microsoft DriveSpace or DriveSpace 3 is not compatible with FAT32. Also, compressed hard disks may not be converted to FAT32.

### How to Use FDISK and FORMAT

Before you install your operating system, you must first create a primary partition on the hard disk on your computer, and then format a file system on that partition.

**FDISK** is a DOS-based tool that you can use to prepare (partition) a hard disk. You can use FDISK to create, change, delete, or display current partitions on the hard disk, and then each allocated space on the hard disk (primary partition, extended partition, or logical drive) is assigned a drive letter.

The Hard Disk may also contain one extended partition, and a second hard disk may contain a primary or extended partition. An extended partition may contain one or more logical MS-DOS drives.

After you use FDISK to partition your hard disk, use **FORMAT** to create the Master Boot Record (MBR) and file system's File Allocation Tables (FAT), storing the necessary disk geometry that allows the hard disk to accept, store, and retrieve data.

When you run FDISK on a hard disk that is larger than 512 megabytes (Mb), you are prompted to choose one of the following file systems:

**FAT16:** This file system has a maximum of 2 gigabytes (Gb) for each allocated space or drive letter. For example, if you use the FAT16 file system and have a 6 Gb hard disk, you can have three drive letters (C, D, and E), each with 2 Gb of allocated space.

**FAT32:** This file system supports drives that are up to 2 terabytes (Tb) in size and stores files on smaller sections of the hard disk than the FAT16 file system does. This results in more free space on the hard disk.

**NOTE:** The FAT32 file system does not support drives that are smaller than 512 Mb.

Consider the following questions before you use FDISK and FORMAT:

\* Is this hard disk the only hard disk on your computer (master) or is this hard disk a second hard disk (slave)?

\* Have you set the jumpers and cabling according to the role of the hard disk (master or slave)?

\* Have you checked your basic input/output system (BIOS) to verify that it supports the hard disk, second hard disk, or a second IDE controller, if applicable? If not, check the

documentation that came with your motherboard, or contact the manufacturer. Typically, the BIOS has an auto detect hard disk setting that configures the drive, but you should verify this before you continue.

\* What type of file system do you want to use? For drives greater than 15 Mb, it must be FAT16 or FAT32. For use on the Z-100, it must use FAT12 or FAT16.

\* Does the hard disk already contain data? Back up your important data before you proceed. When you run the FDISK command to create, delete, or change a partition, all of the data on that partition is permanently deleted. FDISK can, however, view current partition information without deleting your data.

\* Does the hard disk have a drive overlay or a disk management program? If your computer uses drive overlay software to enable large hard disk support, do NOT use FDISK until you have checked with the software manufacturer. See Article KB186057, **How to Tell If Drive Overlay Program Is Installed in Windows** from the Microsoft Knowledge Base at microsoft.com.

\* Do you have the floppy disks or the CD-ROMs necessary to reinstall your software? Make sure you have the software needed to reinstall your programs after you partition and format your drive. If you purchased an upgrade for a program, make sure that you have the full version of the original program. Many upgrades for programs require a compliance check before you can install the upgraded product. If you can not find the original floppy disks or CD-ROMs, contact the software manufacturer before you proceed.

\* Do you have updated device drivers backed up on a device other than the drive that you are about to format and partition? If you have installed an updated device driver for your peripheral devices (for example, modems, printers, and so on), make sure that you back up the new driver on a device other than the drive that you are about to format and partition so that you can reinstall it after you install your operating system.

\* Do you have a Startup disk? Windows 95, Windows 98, Windows 98 Second Edition, and Windows Me prompt you to create a Startup disk during Setup.

If you do not have a Startup disk:

1. Insert a blank floppy disk in the floppy disk drive (drive A).
2. Click **Start**, point to **Settings**, click **Control Panel**, and then double-click **Add/ Remove Programs**.
3. Click **Create Disk** on the Startup Disk tab.
4. After you create the Startup disk, you should test it.

**Note:** To test the Startup disk, insert it in the floppy disk drive, and then restart your computer. If you are using a Windows 98-based computer, the Startup menu is displayed. If you are using a Windows 95-based computer, a command prompt is displayed.

\* Do you need Real-mode CD-ROM support? Some CD-ROM drives require Real-mode device drivers. If you are planning to use Windows 98 on your computer, the Startup disk contains generic, Real-mode ATAPI CD-ROM and Small Computer System Interface (SCSI) drivers that can enable CD-ROM drives after you boot from the Windows 98 Startup disk.

**Note:** These CD-ROM drivers may not work with all CD-ROM drives; they may work as a replacement, if the Real-mode CD-ROM drivers that are included with your CD-ROM drive are not available.

**Note:** If you insert your Windows 98 Startup disk, restart your computer, and are not able to change to the drive letter of your CD-ROM drive (usually one drive letter ahead of where the drive letter typically resides because there is a random access memory [RAM] drive created by the Startup disk), these generic drivers may not work with your CD-ROM drive. View the documentation that is included with your hardware, or contact your hardware manufacturer to obtain the CD-ROM device drivers.

\* Will the drive possibly be used to transfer data between the PC and the Z-100? One of the interesting uses of the IDE drive in the Z-100 is the interchangeability with the PC. The Z-100 IDE Controller will recognize the difference between FAT32 partitions used for the PC's operating system and the FAT16 or FAT12 partitions set aside for the Z-100's use.

**Note:** The Z-100 will not disturb this partition, preserving that as a boot partition on the PC. Because there are so many different PC-clones and operating systems, it is recommended, that the IDE drive be prepared (i.e., formatted) on the PC it may be used on.



## How to Partition a Master Hard Disk

**IMPORTANT:** Changing or deleting partitions will permanently delete any data that was on the partition and it cannot be retrieved. Back up everything that is important to you before you use FDISK.

To partition a master hard disk, run the **FDISK** command:

1. Insert the Startup Disk in the floppy disk drive, restart your computer, and then use one of the following methods, depending on your operating system.

- 1a. For a Windows 98, Windows 98SE, or Windows Me Startup disk:

\* When the Windows 98 Startup menu is displayed, select the **Start computer without CD-ROM support** menu option, and then press ENTER.

\* At a command prompt, type FDISK, and then press ENTER.

\* View step 2.

- 1b. For a Windows 95 Startup disk:

\* At a command prompt, type FDISK, and then press ENTER.

\* View step 2.

2. If your hard disk is larger than 512 MB, you will receive the following message:

*Your computer has a disk larger than 512 MB. This version of Windows includes improved support for large disks, resulting in more efficient use of disk space on large drives, and allowing disks over 2 GB to be formatted as a single drive.*

*IMPORTANT: If you enable large disk support and create any new drives on this disk, you will not be able to access the new drive(s) using other operating systems, including some versions of Windows 95 and Windows NT, as well as earlier versions of Windows and MS-DOS. In addition, disk utilities that were not designated explicitly for the FAT32 file system will not be able to work with this disk. If you need to access this disk with other operating systems or older disk utilities, do not enable large drive support.*

*Do you wish to enable large disk support?*

If you want to use the FAT32 file system, press Y and then press ENTER. However, the FAT32 file system does not support drives that are smaller than 512 Mb.

If you want to use the FAT16 file system, press N, and then press ENTER. The Z-100 IDE Controller will recognize FAT12 and FAT16 for our use.

3. After you press {ENTER}, the following FDISK Options menu (the following may vary by version number) is displayed:

*(Operating System)  
Fixed Disk Setup Program  
(Copyright Information)*

### **FDISK Options**

*Current fixed disk drive: 1*

*Choose one of the following:*

- 1. Create DOS partition or Logical DOS Drive*
- 2. Set active partition*
- 3. Delete partition or Logical DOS Drive*
- 4. Display partition information*
- 5. Change current fixed disk drive*

Note that option 5 is available only if you have two physical hard disks in the computer. If you need to change the partitions on the slave drive, you can press 5 to select "**Change current fixed disk drive**" first to change the current fixed disk drive. This displays a table of the physical drives, any drive letters assigned, the drive sizes in megabytes, the free space remaining, and the percent of usage.

Pressing option 4 to select "**Display partition information**" will display the existing partition on the current drive. Each partition is listed, giving the status, type, volume label (if any), the size in megabytes, the system, and the usage in percent. If there is an Extended DOS Partition containing Logical DOS Drives, you are asked if you wish to see this information.

4. Unless you are using a new drive or have free space on the present drive, you will need to delete one or more of the existing partitions on the drive. To delete a partition or a logical DOS drive, press 3 to select "**Delete partition or Logical DOS Drive**" from the FDISK Options menu. After you press ENTER, the following menu is displayed:

*Delete DOS Partition or  
Logical DOS Drive*

*Current fixed disk drive: 1*

*Choose one of the following:*

- 1. Delete Primary DOS Partition*
- 2. Delete Extended DOS Partition*
- 3. Delete Logical DOS Drive(s)  
in the Extended DOS Partition*
- 4. Delete Non-DOS Partition*

4a. Press 3, and then press ENTER. The "**Delete Logical DOS Drive(s) in the Extended DOS Partition**" screen is displayed with a chart that describes the attributes of your hard disk, as shown in the following example.



```

Drv  Volume Label  Mbytes  System  Usage
D:   (User Defined) 2047   FAT16   100%
E:   (User Defined) 2047   FAT16   100%
F:   (User Defined) 2047   FAT16   100%
G:   (User Defined) 2047   FAT16   100%
H:   (User Defined) 2047   FAT32   17%
I:   (User Defined) 1498   UNKNOWN 13%

```

Total Extended DOS Partition size is  
XXX Mbytes (1 MByte = 1048576 bytes).

WARNING! Data in a deleted Logical  
DOS Drive will be lost.

What drive do you want to delete?

Type the letter for the drive that you want to delete, and then press ENTER.

4b. When you are prompted to type the volume label for the drive, type the volume label if the drive has a volume label.

**Note:** You must type the exact label or press ENTER if there is no volume label. If you type an incorrect label name, you receive the following message:

Volume label does not match.  
Enter Volume Label?

If you type the correct volume label, you receive the following message:

Are you sure (Y/N)?

The default answer to this message is N. You must press Y, and then press ENTER to delete the drive. The words "Drive deleted" are displayed in the chart next to the drive letter that you deleted.

4c. Repeat steps 4a and 4b until you have deleted all of the drives that you want to delete. When you are finished, press ESC.

If you remove all of the logical drives, you receive a "No logical drives defined" message and a chart of drive letters that you changed or deleted. Press ESC to continue.

**Note:** If you want to resize the logical drive or drives by making them larger or smaller, do this now. If you want to remove the extended partition, view step 4f. If you want to make one large Primary Partition, proceed to step 5.

4d. Press 1 to select the "Create DOS partition or Logical DOS Drive" menu option from the FDISK Options menu.

Press 3 to select the "Create Logical DOS Drive(s) in the Extended DOS Partition" menu option from the "Create DOS Partition or Logical DOS Drive" menu, and then press ENTER.

When you do this, you receive a "Verifying drive integrity" message with a percentage-complete counter.

**Note:** When you use this step, the extended partition is NOT deleted, only the logical drive or drives in the extended partition are deleted. You do not need to remove the extended partition to resize the logical drives.

For example, if you have one logical drive in the extended partition and you want to make two logical drives, delete the logical drive and create two logical drives in the extended partition first. Note that you are still limited to the total space in the extended partition.

4e. After the drive verification procedure is finished, you receive the following message:

Total Extended DOS Partition size is  
XXX Mbytes (1 MByte = 1048576 bytes)

Maximum space available for logical drive  
is XXX Mbytes (X%)

Enter logical drive size in Mbytes or  
percent of disk space (%).

The "maximum Mbytes available" is the default size, however, you can change the number if you type the number for the partition size that you want to create, and then press ENTER. Press ESC, press ESC again to quit FDISK and return to a command prompt, and then go to step 10.

4f. If you want to remove the extended MS-DOS partition, press ESC to return to the FDISK Options menu.

Press 3 to select the "Delete DOS Partition or Logical DOS Drive" menu option, press ENTER.

Press 2 to select the "Delete Extended DOS Partition" menu option, and then press ENTER.

4g. The screen shows the current fixed disk drive and information about it. The extended partition is listed in the Type column. For example:

```

~~~~~
Partition Status Type Volume Label Mbytes System Usage
C: 1 A PRI DOS (your label) 1200 FAT16 50%
 2 EXT DOS (your label) 1200 UNKNOWN 50%

```

Total disk space is 2400 Mbytes (1 Mbyte = 1048576 bytes)

You also receive the following warning message:

*WARNING! Data in the deleted Extended DOS Partition will be lost.*

*Do you wish to continue (Y/N)?*

4h. Press Y, and then press ENTER to delete the partition. You receive the following message:

*Extended DOS Partition deleted  
Press ESC to continue*

**Note:** If you try to delete your extended MS-DOS partition before you remove all of the logical drives, you receive the following error message:

*Cannot delete Extended DOS Partition while logical drives exist.*

If you receive this error message, repeat steps 4a through 4c, and then follow steps 4f through 4h to delete the extended MS-DOS partition.

The FDISK Options menu is displayed. If you leave disk space unpartitioned on your hard disk, Windows may not display the full size of your hard disk, only the amount of space that is available.

4i. Once all the partitions have been deleted, press ESC once or twice to return to the FDISK Options menu.

5. Press 1 to select the **"Create DOS partition or Logical DOS Drive"** menu option. After you press ENTER, the following menu is displayed:

*Create DOS Partition or  
Logical DOS Drive*

*Current fixed disk drive: 1*

*Choose one of the following:*

- 1. Create Primary DOS Partition*
- 2. Create Extended DOS Partition*
- 3. Create Logical DOS Drive(s)  
in the Extended DOS Partition*

6. Press 1 to select the **"Create Primary DOS Partition"** menu option. After you press ENTER, you receive the following message:

*Do you wish to use the maximum available size for primary DOS partition?*

After you receive this message, use one of the following methods, depending on the file system that you selected:

For a FAT32 File System:

a. If you press Y for the FAT32 file system (in step 2) and you want all of the space on the hard disk to be assigned to drive C, press Y, and then press ENTER.

b. Go to step 9.

For a FAT16 File System:

a. If you press N for the FAT16 file system (in step 2), you can accept the default 2 GB size for the partition size, or you can customize the size of the partition.

To accept the default partition size:

a. If you want the first 2 Gb on the hard disk to be assigned to drive C, press Y, and then press ENTER.

b. Press ESC to return to the FDISK Options menu, and then go to step 6d.

To customize the partition size:

6a. If you want to customize the size of the partitions (drive letters) on the hard disk, press N, and then press ENTER.

6b. A dialog box is displayed in which you can type the size for the primary partition in MB or percent of disk space.

**Note:** For computers that are running either Windows 98 or Windows Me, Microsoft recommends that you make the primary partition at least 500 Mb in size. Type the size of the partition you want to create, and then press ENTER.

6c. Press ESC to return to the FDISK Options menu.

6d. To assign drive letters to the additional space on the hard disk, press 1 to select the **"Create DOS Partition or Logical DOS Drive"** menu option. After you press ENTER, the following menu is displayed:

- 1. Create Primary DOS Partition*
- 2. Create Extended DOS Partition*
- 3. Create Logical DOS Drive(s)  
in the Extended DOS Partition*

6e. Press 2 to select the **"Create Extended DOS Partition"** menu option. After you press ENTER, a dialog box displays the maximum space that is available for the extended partition. You can adjust the size of the partition or use the default size.

**Note:** The default maximum space is recommended, but you can divide the space between multiple drive letters. Type the amount of space that you want, press ENTER, and then press ESC.

6f. The **"Create Logical DOS Drive(s) in the Extended DOS Partition"** menu is displayed. This is the menu that you can use to assign the remaining hard disk space to the additional drive letters.

Type the amount of space that you want to assign to the next drive letter in the **"Enter logical drive size in Mbytes or percent of disk space (%)"** box, and then press ENTER.

6g. A table that lists the drive letter that you created and the amount of space on that

drive is displayed. If there is free space on the hard disk, it is displayed near the bottom of the table. Repeat steps 6e and 6f until you receive the following message:

*All available space in the Extended DOS Partition is assigned to local drives.*

6h. After you receive this message, press ESC to return to the FDISK Options menu.

7. To activate the partition from which you plan to boot (usually drive C), press 2 to select the **"Set active partition"** menu option. When you press ENTER, you receive the following message.

*Enter the number of the partition you want to make active.*

8. Press 1, and then press ENTER.

9. Press ESC to return to the FDISK Options menu and then press ESC again to quit FDISK. Before returning to the command prompt, the computer will display a note:

*You **MUST** restart your system for your changes to take effect. Any drives you have created or changed must be formatted **AFTER** you restart.*

*Shut down Windows before restarting.*

10. Press ESC to exit FDISK. Proceed with **How to Format a Hard Disk**, described later.

## How to Repartition a Slave Hard Disk

If you want to add a second hard disk (slave drive) to your computer, first ensure that the jumpers on both the master (original) and slave (new drive) are set according to the manufacturer's instructions so your computer can properly detect the hard disks.

After verifying your hardware is installed correctly, you can either run FDISK from your startup disk as described earlier or from within Windows by following these steps:

1. Click **Start**, point to **Run**, and then type **COMMAND** (Note that the **cmd** command only works on Windows 2000-based computers).

2. At a command prompt, type **FDISK**, and then press ENTER. The following menu is displayed:

1. Create DOS partition or Logical DOS Drive
2. Set active partition
3. Delete partition or Logical DOS Drive
4. Display partition information
5. Change current fixed disk drive

Note that menu option 5 is available only if you have two physical hard disks on your computer.

3. Press 5, and then press ENTER. When you do this, the selection changes from the physical disk 1 (master) to the physical disk 2 (slave).

4. Press 1 to select the **"Create DOS partition or Logical DOS Drive"** menu option, press ENTER, press 2 to select the **"Create Extended DOS Partition"** menu option, and then press ENTER.

When you make your slave drive an extended MS-DOS partition, your drive letters do not change. For example, if the first drive contains partition C and partition D, your slave drive becomes D unless you set the slave drive as an extended partition.

If you skip this step and just create another primary MS-DOS partition for the slave drive, the new drive becomes drive D and what used to be drive D, changes to drive E.

5. You can partition the slave drive to make other logical drives just as you did with the original master drive.

If your computer cannot detect the new drive, you may need to add the following line to your CONFIG.SYS file, where 'drive' is a letter that is greater than the last drive letter on the computer (including the CD-ROM drive):

**LASTDRIVE=drive**

6. After you finish using FDISK, format the new partitions so that you can use them. See the section **How to FORMAT Your Hard Disk**, next. After you press ESC to quit FDISK, restart your computer to start Windows.

## How to Format a Hard Disk

After you create the partitions, you must format the partitions. If this was the Master Disk, you must use the following procedures. If you are going to format the slave, you may restart the computer and perform the format from within Windows.

### FORMAT from the Startup Disk:

1. Restart your computer with the Startup disk in the floppy disk drive.

**Note:** If you are using a Windows 95 Startup disk, a command prompt is displayed and you can skip to step 2. If you are using a Windows 98, Windows 98SE, or Windows Me Startup disk, select the **Start computer without CD-ROM support** menu option when the Windows 98 Startup menu is displayed.

2. When a command prompt is displayed, type **FORMAT C:/s**, and then press ENTER. This command transfers the system files and should only be used when you format drive C (or your "active" drive). For all other partitions, type **FORMAT drive:** (where 'drive' is the letter of the partition that you want to format).

**Note:** If you receive a "Bad command" or "Bad file name" error message, you may need to extract FORMAT.COM to your boot disk. To do this, type the following command at a command prompt, and then press ENTER:

## EXTRACT EBD.CAB FORMAT.COM

After FORMAT.COM is extracted to your boot disk, try the FORMAT command again.

3. When you successfully run FORMAT, you receive the following message:

```
WARNING, ALL DATA ON NON-REMOVABLE DISK
DRIVE C: WILL BE LOST!
Proceed with Format (Y/N)?
```

4. Press Y, and then press ENTER to format drive C.

5. After the format procedure is finished, you receive the following message:

```
Volume label (11 characters, ENTER
for none)?
```

**Note:** This is an optional feature that can be used to type a name for the drive. Either type an 11-character name for the drive, or leave it blank by pressing ENTER.

### FORMAT from within Windows:

To format your new partition or partitions, use one of the following methods, depending on your file system.

For a FAT16 file system:

1. Double-click **My Computer**, right-click the partition that you just created, click **Format**, click **Full**, and then click **Start**.

2. After the format procedure is complete, click **OK** to close the dialog box.

For a FAT32 file system:

1. Click **Start**, point to **Programs**, point to **Accessories**, point to **System Tools**, click **Drive Converter (FAT32)**, and then click **Next**.

2. In the Drives box, click the drive you want to convert to the FAT32 file system.

3. Click **Next**, and then click **OK**.

4. Click on **Next** three times.

5. When the conversion procedure is finished, click **Finish**.

**Note:** Do not use the /s switch that you used when you set up drive C. This was only used to place the System Files on the partition. All we are doing now is to format the drive or drives so that you can use them. Also, if you created two new drive letters, you need to format both drives.

When you successfully run the FORMAT.COM utility, you receive the following message:

```
WARNING, ALL DATA ON NON-REMOVABLE DISK
DRIVE X: WILL BE LOST!
```

Proceed with Format (Y/N)?

Press Y, then press ENTER to begin format.

After the format procedure is finished, you will receive the following message:

```
Volume label (11 characters, ENTER for
none)?
```

**Note:** This is an optional feature that you can use to type a name for the hard disk. You can either type an 11-character name for the drive, or leave it blank and press ENTER.

### MS-DOS FDISK Problems with IDE Devices

**Note:** While IDE Devices usually come prepared with one large partition, we must use a PC-clone to create smaller partitions on the IDE device for efficient use in the Z-100.

**CAUTION:** The Microsoft version of FDISK that I just explained above in such great detail, had some difficulty creating the partition sizes necessary.

So now I use Free FDISK, which is very similar, but does the job properly. However, it also has a problem adjusting the size of the last partition (you need to make the last partition 2 or 3Mb less than the calculated size, or the partition has problems).

These limitations or issues may have been corrected in later versions, but Free FDISK works for me and I have not taken the time to try others. If someone has had success with later MSDOS versions, please let me know.

**Note:** The PC clone I am using is a bare bones computer (no case, no hard drive, no Windows installation) with a 486 processor. All you need is a main board, power supply, keyboard, monitor, floppy drive and the IDE device to prepare (CF card adapter or IDE drive).

**CAUTION:** Some, more recent computers have Compact Flash and other memory card readers already installed. These will **NOT** work. They are only meant to read and write files from memory cards and do NOT simulate the full workings of an IDE drive.

### Procedures to prepare a Compact Flash Card:

\* Install the CF card in a CF to IDE adapter attached to the IDE connector on your PC-clone.

**Note:** Never install or remove a CF card with power ON. It may cause damage to the card.

\* Boot to DOS with a Win95 or Win98 startup disk.

\* Change to a Free FDISK floppy and run FDISK.

\* On 512Mb CF cards, I generally create the following partitions (Smaller cards would have fewer or smaller partitions):

- Delete PriDOS partition C: ~512Mb  
This removes the existing large partition.
- Create PriDOS partition C: 30Mb
- Create PriDOS partition D: 30Mb
- Create PriDOS partition E: 30Mb

**Note:** The MSDOS FDISK only allows one Primary DOS partition and requires the rest of the devices memory be placed in the Extended DOS partition, which can be further subdivided into smaller partitions, by drive letter.

Free FDISK will allow up to four Primary DOS partitions. If you want more partitions, the fourth primary DOS partition must be removed and a large Extended DOS partition created. The next step will create one large Extended DOS Partition, which will then be divided further.

- Create ExtDOS partition:

Make this partition 2-3Mb less than the size given by FDISK.

- Create Drive D: 100Mb
- Create Drive E: 298Mb

**Note:** The Primary DOS partitions that were D: and E: now become F: and G: automatically.

- Make partition E: active.
- Display partition info, with extended drives, if you wish to check status.

\* Restart the PC-clone computer to recognize the new partitions on the IDE device.

- \* Run FORMAT on each of these drives:
  - FORMAT C: and name WP (~30Mb)
  - FORMAT D: and name ZDOS4 (~100Mb)
  - FORMAT E: and name PCPART (~298Mb)
  - FORMAT F: and name CALC (~30Mb)
  - FORMAT G: and name DATA (~30Mb)

\* Run SCANDISK on each drive letter to ensure there are no glitches or errors. This is the only time you will be able to check the IDE device for memory errors using SCANDISK.

**Note:** SCANDISK (at least the WIN 95 and 98 versions) will cause errors with the File Allocation Tables (FAT) after files are copied to the partitions from a Windows computer. It will ask to fix these and fix filenames that are longer than 8 characters in length (DOS). Do **NOT** allow SCANDISK to fix FAT errors on any partition/drive. It is also best to **NOT** use SCANDISK after copying files to a partition /drive.

You may have noticed that I used the label PCPART for the last huge partition. As I mentioned earlier, large CF cards are just too much space for most uses on the Z-100. But that the same CF card could be used on a PC clone with its own CF adapter installed. The extra space could be used by the PC.

**Note:** For some reason the drive letters get mixed up between FDISK, a PC, and the Z-100, so watch what the partition names are, before copying, moving or deleting files.

Preparing the partitions with Free FDISK in the order given above, creates the same partition order (30, 30, 30, 100, and 298) on the Z-100.

ALL the drives can be seen on the Z-100 and an early PC (later PCs only show the active one), making an excellent means of copying files between the PC and the Z-100. For example, you may recall, the new ZDOS versions are provided on CD-ROM. If you use the CD-ROM on a PC with a IDE/CF adapter, you could copy the files from the CD to the IDE CF and then use them on the Z-100. However, there is a catch...

While files can be placed on a partition by either the Z-100 or the PC, a PC using Windows uses longer directory and file names than DOS.

The directory tree being used on the CD-ROM uses longer names because I have the entire Z-100 Library on a Windows PC, which makes it much easier to identify what files are where.

DOS computers shorten these longer directory and file names to the first six letters, then add a tilde (~), then a number, generally a 1.

Subsequent files with the same first six letters then become 2, 3, etc.

Further, on the Z-100, DOS displays additional volume labels that contain the missing filename information. ZDIR shows these additional volume labels in the form:

```
AD.O.S.4.H. <vol>
AD.i.a.g.l. <vol>
AL.L.i.d.e. <vol>
AP.k.Z.i.p. <vol>
```

that make up additional lines in the directory.

If the floppy disk or CF partition is placed back in a Windows computer, the entire longer file names are regenerated and used.

**CAUTION:** These volume labels cannot be copied, deleted, or renamed by DOS (they are not seen). Also, if a directory or partition containing these extra volume names is copied to another directory or partition, the volume labels are lost, and a Windows PC would no longer be able to generate the longer file names.

I hope this article has been of help to you. If you have any questions or comments, please email me at:

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Cheers,

Steven W. Vagts