

# Getting to Know the Lexar Media 4GB

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You can never be too rich, too thin or have too much camera storage media

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## Introduction

Lexar Media's Pro Series 4GB 40X is the first CompactFlash card from a major manufacturer to break the 2GB barrier, and the first CompactFlash card with 4GB of capacity *ever*. Making best use of a card this roomy requires an understanding of its benefits to the serious and professional photographer. It also requires a careful examination of your workflow, to ensure that your camera and your current card handling practices are 4GB-friendly.

This document provides an in-depth look at the Lexar Media Pro Series 4GB 40X CompactFlash card. It is divided into the following sections:

- Why 4GB?
- Breaking the 2GB Barrier is a Big Deal
- Ensuring Your Camera is Compatible
- Formatting and Usage Tips
- Glossary of Terms

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## Why 4GB?

Every photographer has a card capacity sweet spot, or the capacity they find to be ideal. That sweet spot varies with the camera, its resolution and the file format in which photos are being recorded. It also varies with the needs of the assignment being photographed: some assignments are best suited to a handful of lower-capacity cards, while others assignments only become practical if the card is the highest capacity available.

Loosely translated, this means you can never be too rich, too thin or have too much camera storage media. In designing the 4GB 40X CompactFlash card, Lexar Media envisioned several key benefits to all that capacity for the serious and professional photographer:

**Remote or underwater applications** If your digital camera is submerged several hundred feet underwater, or is suspended behind the basket during a playoff game, it may be impractical to change cards often, or at all. For remote or underwater photography, 4GB of capacity is an asset.

**Extreme photography** If you shoot pictures while perched on the side of a cliff face, from the back of a speeding motorcycle or in weather that has chased everyone else indoors, a 4GB CompactFlash card means not having to fuss with changing cards when it would be dangerous to do so, or would expose the innards of your digital camera to the elements.

**Shooting for quality** If your camera is set to RAW or TIFF a lot more often than JPEG, 4GB of capacity means not having to stop shooting often to swap cards.

**Shooting forever** If you simply like the freedom of shooting, shooting, shooting, and dislike having to keep track of a camera bag full of CompactFlash cards, 4GB might just be your card capacity sweet spot.

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## Breaking the 2GB Barrier is a Big Deal

CompactFlash storage media is definitely state of the art; the method used for tracking and referencing stored photos on CompactFlash cards is most definitely not. And that's a good thing. By standardizing on a variant of the file system first introduced over 20 years ago, digital camera and card manufacturers have ensured the broadest possible compatibility between their respective products.

The file system used by all digital cameras that accept CompactFlash storage media is one of three versions of FAT. FAT is an acronym for File Allocation Table, which itself is one of the key elements in the FAT file system. The file system keep track of where each picture is stored on the card. A FAT file system makes its way onto the card through a process called formatting. During the formatting process, the components of the file system – File Allocation Table, Master Boot Record and more - are added to the card's data storage area, in effect preparing the card to receive data from your digital camera.

For capacities between about 16MB and 2GB, digital cameras expect the card to contain a FAT16 file system. It's called FAT16 because it uses 16-bit numbers to reference locations where data is stored on the card.

On the surface, it would seem to make sense for all CompactFlash cards, even those with capacities greater than 2GB, to be formatted FAT16. After all, it's safe to assume than any digital camera that accepts CompactFlash media will be FAT16-savvy. Unfortunately, FAT16 simply wasn't designed to track files on media larger than 2GB.

FAT32, the latest FAT twist, uses 32-bit numbers to point to where the bits and pieces of a file are stored. As a result, FAT32 supports media up to 2 Terabytes (TB) in size. Any card that breaks the 2GB barrier, then, must be formatted FAT32 to both take advantage of the full capacity of the card, as well as to ensure full compatibility with modern PC and Mac operating systems. FAT16 support in digital cameras today is a given; support for FAT32 is not.

In the *Ensuring Your Camera is Compatible* and *Formatting and Usage Tips* sections we'll discuss the implications of the FAT32 file system and digital cameras in greater detail. For now, it's important to understand that any card with a capacity of more than 2GB will be fully compatible only with cameras that explicitly support FAT32 (many don't), and that your computer may choke if you try to copy photos from a more-than-2GB card that has been formatted FAT16 (which is possible, though you'll only have access to a maximum of about 2GB of the card's actual capacity).

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## Ensuring Your Camera is Compatible

The first step to ensuring your camera is compatible is to consult the list of FAT32-capable cameras on the Lexar Media web site:

<http://www.lexarmedia.com/fat32>

### **Cameras that accept CompactFlash Type II that are also FAT32-compatible:**

Canon Powershot G3  
Canon Powershot G5  
Canon Powershot S45  
Canon Powershot S50  
Canon EOS 10D  
Canon EOS-1Ds

Kodak DCS 720X<sup>1</sup>  
Kodak DCS 760<sup>1</sup>  
Kodak DCS Pro Back (all models)  
Kodak DCS Pro 14n

Olympus E-1

<sup>1</sup> A CompactFlash-to-PC Card adapter is required with these models

Next, it's important to understand that there are different levels of compatibility among current FAT32-compatible cameras. While any camera that claims to be FAT32-capable can be expected to read and write to a FAT32-formatted card without incident, some cameras are tripped up by cards larger than 2GB that are completely unformatted, while others may take many times longer to apply a FAT32 format.

For example, the FAT32-compatible Canon EOS-1Ds will FAT16 format any card that is unformatted, even ones larger than 2GB. These are some of the twists and turns you need to be aware of when working with camera storage media with capacities greater than 2GB.

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## Formatting and Usage Tips

**What is formatting?** Installing a FAT file system onto camera storage media really involves two separate and distinct steps: *partitioning* and *formatting*. To add partition information, a Master Boot Record (containing a Partition Table) has to be written to the first data location (called the first *sector*) of the card. Formatting then adds a Partition Boot Record, two copies of the FAT Table and a Root Directory. Though there are some key differences between a FAT16 file system and FAT32, the basis elements of each are the same.

Note: See the Glossary of Terms at the end of this document for more information on the key elements of the FAT file system.

The formatters in most or all-digital cameras actually partition the media first, and then format it. As a result, the terms format or formatting, at least as they apply to digital cameras, are now more commonly

used to describe partitioning and formatting together. Put simply, formatting is the process of organizing a card so that it can store data.

The formatting applied by modern computers and digital cameras doesn't actually change the physical structure of the card. This means that a card can be formatted with the same file system over and over, or reformatted with a different file system, at any time.

As you and your high-capacity CompactFlash cards enter the brave new world of FAT32, some of your standard card-handling practices may need to change. Here are some suggestions for trouble-free use of camera storage media larger than 2GB, including the Lexar Media Pro Series 4GB 40X CompactFlash card, with today's digital cameras and computer operating systems.

**Ensure your camera's firmware is up to date** Some cameras, including several in Kodak's DCS lineup, gain FAT32 compatibility only with the installation of the newest firmware into the camera.

**Get to know Image Rescue** Included with all Lexar Pro Series CompactFlash cards, Image Rescue does more than recover photos. Among its suite of functions is a formatter that can restore the FAT file system on any supported card to factory-fresh condition.

If you get yourself into a jam by, for example, formatting a larger-than-2GB card in an older digital camera that only speaks FAT16, the quickest way out is to reformat the card using Image Rescue. The program will apply a factory-new FAT32 file system on Lexar Media cards with capacities over 2GB, thereby restoring the card's proper functionality. Some cameras that are FAT32-capable may simply reformat the card FAT16 if they detect an intact FAT16 file system is there already, so an Image Rescue format will sometimes be mandatory to bring back FAT32.

The same applies if the file system on the card becomes corrupted (which can occur if any card is pulled out of the camera while it's still writing, for example). Use the format function in Image Rescue to ensure that the card is properly reformatted. Since some cameras will FAT16 format cards over 2GB that lack an intact file system (as could be the case with a corrupted card), formatting with Image Rescue will give you peace of mind that the card has been reformatted properly.

Once you've formatted a larger-than-2GB card with Image Rescue, using the format function of any FAT32-compatible camera to prepare it for reuse thereafter should be fine. But whenever you think something is amiss with the file system on the card, fire up Image Rescue's format function once again.

**Avoid FAT16** Though it's possible to FAT16-format a larger-than-2GB card, doing so limits the card's capacity to about 2GB. In other words, the Lexar Media Pro Series 4GB 40X CompactFlash card, when formatted FAT16, will be temporarily turned into about a 2GB card. Moreover, your computer may not be able to read cards over 2GB that are formatted FAT16; a Mac running OS X 10.2.6, for example, will prompt you to initialize (another word for format) the Lexar Media Pro Series 4GB 40X if it detects a FAT16 file system. If your camera isn't FAT32-ready you would be well advised to stick with 2GB and smaller CompactFlash cards.

**Be aware of the FAT32 bottleneck** Because of the manner in which many digital cameras update the file system as they write photos to the card, writing to a FAT32-formatted card generally takes a little longer than writing to a FAT16-formatted card with similar performance capabilities. For instance, the Canon EOS 10D will write the same photo to a FAT16-formatted Lexar Media Pro Series 2GB 40X CompactFlash card somewhat faster than to a Lexar Media Pro Series 4GB 40X CompactFlash card, despite the fact that both cards are 40X models.

**No, the frame counter isn't broken** Insert a high-capacity card like the Lexar Media Pro Series 4GB 40X and look at the frames remaining counter as you squeeze off an extended sequence. If the camera is the Canon EOS 10D, and the file format is JPEG, you may be surprised to see the counter stick at 999

for a good long time before it counts down to 998. This is normal for this camera, and is not a sign that no photos are being written to the card.

This behavior is not a result of FAT32 formatting, and will occur when the file size of the selected format is small and the card's capacity is large.

**The D is a feature** Mac OS X 10.2.6 (and probably other Mac OS versions too) does a curious thing to the name of a FAT32-formatted card with a capacity greater than 512MB: it appends the letter D. If the card's name is EOS\_Digital, it will be transformed temporarily into EOS\_DigitalD. The card's name isn't actually altered; the superfluous D only appears when the card is mounted on the Mac's desktop.

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## Glossary of Terms

**Byte** - An abbreviation for binary term, it is a single unit of data composed of 8 bits, where each bit is either a zero or a one.

**Cluster** - A storage unit in the FAT file system made up of a collection of sectors. In the FAT16 file system, the number of sectors per cluster varies, but is fixed at 8 sectors per cluster in FAT32.

**Data Area** - Following the Root Directory is the area on the card where any folders, as well as the actual data, are stored.

**File Allocation Table (FAT)** - Both the name of a family of file systems, and the element in the file system that immediately follows the Partition Boot Record. For efficiency, the FAT tracks which sectors are written to in groups of sectors called clusters. Each entry in the FAT corresponds to a single cluster location in that partition's data storage area. When a photo is written to the card, the FAT records all the clusters the photo is occupying. So critical is the integrity of the FAT, especially in the event of a file system mishap, that two identical copies are maintained on the card.

**Formatting** - See *What is formatting?* in the *Formatting and Usage Tips* section.

**Gigabyte (GB)** - Data storage manufacturers typically define a gigabyte as 1,000,000,000 bytes, while most cameras and computer operating systems define it as 1,073,741,824 bytes. This explains why there is usually a difference between the rated capacity of a hard drive, CompactFlash card or other storage media and the capacity reported by your camera or computer.

**Host-addressable** - The area on the CompactFlash card that a camera or computer can read from and write to. For example, when a digital camera is transferring photos to the card, reading photos from the card, updating the FAT table or formatting it's accessing only the card's host-addressable areas. Separate, non-host-addressable areas contain the code that enables the card to function, including its firmware.

**Master Boot Record** - This is a 512-byte entry that occupies the first available location on the card, usually known as the first physical sector. It can contain several elements, the most important of which is the Partition Table. The Partition Table lists the start and end points of partitions on the card. In the same way partitions divide up a room, partitions divide up the available space on a CompactFlash card. This analogy is strained, however, by the fact that CompactFlash cards destined for use in a digital camera must contain only a single partition for the maximum capacity of the card to be available to the camera, or even to be recognized at all by the camera.

Put another way, a partition outlines the *logical* structure of a card; it sets out the boundaries of what we think of as the card's available storage area. The FAT file system depends on an intact logical structure

housed within the boundaries of a partition. This is separate from the *physical* structure of the card, which is defined by some hidden code. The physical structure of the card remains the same regardless of the logical structure overlaid by a FAT file system, or any other file system for that matter.

**Megabyte (MB)** – Data storage manufacturers typically define a megabyte as 1,000,000 bytes, while most cameras and computer operating systems define it as 1,048,576 bytes. This explains why there is usually a difference between the rated capacity of a hard drive, CompactFlash card or other storage media and the capacity reported by your camera or computer.

**Partition** - see *Master Boot Record*.

**Partition Boot Record** - Also referred to as the DOS Boot Record or the Boot Sector, this is the first sector of a card's partition. It outlines key file system details such as the number of sectors per cluster (important when formatted FAT16), the file system in use (i.e. FAT32) and more. Interpreting the Partition Boot Record enables the camera or computer to locate and interact with the file system correctly.

**Root Directory/sub-directories** - Every photo, sound or other file tracked in the FAT has a corresponding directory entry. Directory entries are separate from the FAT, though they work hand in hand with it. Each directory entry contains the file's name, its size, when it was created, whether it's read-only (as it will be if it was marked as protected in the camera), a reference to the cluster in which the file begins and more. Directory entries are found in two locations - the Root Directory (of which there is only one) or a subdirectory (of which there can be many).

The Root Directory, a master directory that lists all the files and folders (called subdirectories) on the card, starts after the end of the second FAT.

When a photo or sound file is deleted in the camera, the bits and bytes that make up the file aren't actually removed from the card. Instead, the file's directory entry is marked as unused, and the trail of entries in the FAT that point to the file are reset to zero.

**Sector** – In the FAT file system, a sector is 512 bytes.