

The Nuts and Bolts of MP3 Players

“Personal music player technology has made some huge advancements.”

by Pete Choppin

Of the recent evolutions of music formats—from the 8-track tapes to vinyl records to CDs—none of the earlier music formats provide the convenience and control that MP3 players deliver. When you can carry thousands of songs wherever you go in the palm of your hand, organize them into playlists, and then have the ability to play your songs on any number of devices, it is clear that personal music player technology has made some huge advancements.

Think of all that stored music, and the MP3 player itself, weighing in at less than one ounce. Portability, in large measure, plays a huge part in the popularity of the MP3, considering the ease of transportation in comparison to a CD player and CD storage—and that's in addition to the ability of some devices to provide additional technology, such as video and photo viewing, calendar functions, and even cell phone and Internet service.

In this article, we'll be discussing the technology inside MP3 players and the different types of players available.

The MP3 File Format

In the late 1990s, when file-swapping services and the first portable MP3 players made their debut, the MP3 file format revolutionized music. MP3, or MPEG Audio Layer III, is one method for compressing audio files. MPEG is the acronym for Moving Picture Experts Group, a group that has developed compression systems for video data, including those for DVD movies, HDTV broadcasts and digital satellite systems.

Using the MP3 compression system reduces the number of bytes in a song, while retaining sound that is near-CD quality. Anytime you compress a song, you will lose some of its quality, which is the trade-off for the ability to carry more music files in a smaller storage system. A smaller file size also allows the song to be downloaded from the Internet faster.

Consider that an average song is about four minutes long. On a CD, that song uses about 40MB, but uses only 4MB if compressed through the MP3 format. On average, 64MB of storage space equals an hour of music. A music listener who has an MP3 player with 1GB of storage space can carry about 240 songs or the equivalent of about 20 CDs. Songs stored on traditional CDs are already decompressed, so it takes more CDs to store the same amount of songs. (Some CDs support MP3 files.)

Although MP3 is perhaps the most well-known file format, there are other file formats that can be played on MP3 players. While most MP3 players can support multiple formats, not all players support the same formats. Among these are WMA (Windows Media Audio), WAV (Waveform Audio), MIDI (Music Instrument Digital Interface), AAC (Advanced Audio Coding), ASF (Advanced Streaming Format), and ATRAC (Sony's Adaptive Transform Acoustic Coding

3).

Inside the Player

Unlike earlier forms of music players that required moving parts to read encoded data on a tape or CD, MP3 players use solid-state memory. An MP3 player is no more than a data-storage device with an embedded software application that allows users to transfer MP3 files to the player. MP3 players also include utilities for copying music from the radio, CDs or Web sites, and the ability to organize and create custom lists of songs in the order you want to hear them. This list of songs is called a playlist .

Specific components may vary, but the basic parts of a typical MP3 player consists of a data port, memory, microprocessor, digital signal processor (DSP), display, playback controls, audio port, amplifier and power supply.

The MP3 player is a combination of many technologies. Alone, none of its components are revolutionary, but together they create an unprecedented consumer product.

The player plugs into your computer's USB port, FireWire port or parallel port to transfer data. USB-based players transfer data many times faster than those that use the parallel port. The MP3 files are saved in the player's memory.

The type of memory MP3 players use is solid-state memory. The advantage of solid-state memory is that there are no moving parts, which means better reliability and no skips in the music. Some players may also contain tiny hard disk drives, which can store 10 to 150 times more than Flash memory devices.

In addition to storing music, the MP3 player must play music and allow the user to hear the songs played. To do this, the player:

1. Pulls the song from its memory.
2. Decompresses the MP3 encoding, through DPS, via an algorithm or formula.
3. Runs the decompressed bytes through a digital-to-analog converter into sound waves.
4. Amplifies the analog signal, allowing the song to be heard.

All of the portable MP3 players are battery-powered. Most use a rechargeable internal lithium battery and last for approximately 10 to 24 hours on a single charge. Many of the players also have AC adapters so they can be plugged into a normal electrical outlet, and some even offer DC adapters for use in a car.

Types of MP3 Players

MP3 players are as varied as the people who buy them. Choice is based on several factors, including how you plan to use it, the amount of music you want to carry in your MP3 player and how much you are prepared to pay. Let's take a look at the four basic types of MP3 players.

Flash Memory Players

The flash memory MP3 player is the smallest and lightest, and typically stores fewer songs than hard drive players. Because it's small and contains no moving parts, it's ideal for joggers, bikers or anyone on the move, and with some models boasting up to 8GB of storage (2,000 songs) and other models offering video and photo capability, it also appeals to the multimedia aficionado. Its batteries can last up to 24 hours.

Hard Drive and Mini-Hard Drive Players

Hard drive players are larger and heavier than flash memory players and offer considerably more storage. (The Apple iPod holds up to 80GB.)

For those looking for a player that can contain their entire music collection (up to 20,000 songs), photographs, data and video, and allow podcast recording, the hard drive is best. However, these features and the hard drive consume more power, with some batteries lasting eight to 20 hours for music playback and up to six hours for video playback. The players include moving parts, which may skip. However, some players have anti-shock buffers and/or anti-skip protection.

Smaller in size and internal storage capacity, miniature-hard drive players are lighter than traditional hard drive players, but contain less memory—usually up to 8GB. They, too, contain moving parts.

MP3 CD Players and MiniDisc MP3 Players

There is a breed of CD players available that plays MP3 and other digital files. These MP3 files are burned to CD-R/RW discs from your old CD collection and used in the MP3 CD player. A CD can hold about 10 hours of music. A CD burner is necessary for those buying an MP3 CD player. The MP3 CD player is cheaper than the flash memory and hard drive memory players, but may skip when jostled. They are also much larger in size than their digital counterparts.

For those who appreciate MiniDisc technology, there's Sony's MiniDisc Walkman digital music player. This player supports the trademark Sony file format codec ATRAC3—but it also supports MP3, WMA and WAV formats. And the multitasking doesn't stop there. Sony reports that the 1GB Hi-MD discs can also store and transfer loads of PC data files (think PowerPoint presentations, spreadsheets, etc.). The discs retail for less than \$10, store up to 600 songs and are re-recordable. Depending on the model, users can expect anywhere from 30-plus hours of playtime from just one AA battery.

The Hybrid Players

MP3 is no longer just a stand-alone technology. Technology companies are now offering MP3 capability in other consumer products, including satellite radios, personal digital assistants, DVD players, sunglasses, swim goggles and even a combination Swiss Army Knife-MP3 player. Most notably, the iPhone from Apple crosses a cell phone with an iPod and Web browser, along with a variety of other features.

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Digital music has been around now for many years, and it is clear that the digital media players are only going to increase in capacity, speed and features.