Guide to common music file types and formats

The following provides an overview of the various types of music file formats available and the playback environments they are suited for.

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http://www.audiostream.com/content/guide-common-music-file-types, Jul 2013

PCM – Pulse-code modulation (PCM) is the most common method of storing analog audio signals in digital format. CD data is stored as PCM data as are most of the file formats associated with digital downloads.
In a PCM stream, the analog waveform is represented by two values; the sample rate which represents the number of times per second a sample is taken, and the bit depth which represents the number of possible values each sample can have. A file's bit rate is obtained by multiplying its bit depth times the sample rate, times the number of channels (for stereo that means x2). So a CD's bit rate is equal to 1,411kbps (16 x 44,100 x 2).

For digital downloads, common bitrates, bit depth and sample rates include 256kbps, 320kpbs, 16-bit/44.1kHz (CD-quality or Redbook), 16-bit/48kHz, 24-bit/44.1kHz, 24-bit/48kHz, 24-bit/96kHz, 24-bit/172.4kHz, and 24-bit/192kHz. We are also seeing Digital eXtreme Definition (DXD) files becoming available which are PCM files with a bit depth and sample rate of 24-bit/352.8kHz. There is also some debate as to what represents a High Definition (HD) download. Some people feel that any file with a bit depth of 24-bit is HD, while others restrict this classification to files with a sample rate of 48kHz or greater. AudioStream has taken the position that 24-bit/48kHz and greater resolutions represent HD.

Beyond bit and sample rates, PCM data can be stored in a number of file formats which are either uncompressed or compressed. Compressed files are further broken down into either lossy or lossless compression. An uncompressed file format means that the associated data has not been altered in any way. It is stored bit for bit. A compressed file format means the data has been altered in order to achieve a smaller file size. In lossless compression, all of the original data is kept while in lossy compression some data is discarded, i.e. thrown away forever.

PCM Lossy Compressed File Formats – Lossy compressed formats are used by streaming services like Pandora and Spotify and remain the download format of choice for sites like Amazon and the iTunes store. You can think of lossy compressed formats as the fact food of downloads and while they are perfectly suitable for streaming services due to their reduced file size, when paying for downloads we recommend sticking with lossless and uncompressed formats due to their improved sound quality. It's important to note that you should not convert a lossy compressed file from one lossy format to another since with each conversion you will lose more musical data.

AAC – Advanced Audio Coding (AAC) or MPEG-4 File Format, V.2 with Advanced Audio Coding. AAC is a lossy compressed file format designed to be the successor to MP3 and is used by sites like the iTunes Store for its music downloads (bitrate: 256kbps) and YouTube for its streaming audio.

MP3 – The original and still most popular and widely supported lossy compressed file format which became an MPEG (Moving Picture Experts Group) standard in 1993. Amazon, among many others, uses MP3 as the delivery format for its music downloads (average bitrate: 256kbps).

OGG Vorbis – OGG Vorbis is an open source lossy compressed file format developed by the the Xiph.Org Foundation. Among others, Spotify uses the Vorbis format for its streaming services and offer three levels of quality: 96kbps (Spotify mobile "Low bandwidth" setting), 160kbps (Spotify Desktop standard streaming quality), and 320kbps (Spotify Mobile "High quality" setting).

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WMA – Windows Media Audio (WMA) is Windows proprietary codec and comes in a lossy compressed version as well as a lossless compressed version, WMA Lossless.

PCM Lossless Compressed File Formats – Since lossless compression is just that, lossless, all of the original data remains in tact unlike lossy compression which discards musical data in order to achieve smaller file sizes. You can convert from one lossless format to another or to an uncompressed format with no loss of data.

ALAC – Apple Lossless Audio Codec (ALAC) is Apple's open source (since 2011) lossless compressed file format.

APE – Monkey's Audio (Monkey's Audio APE) is a lossless compressed format.

FLAC – Free Lossless Audio Codec (FLAC) is the most common lossless compressed file format for music downloads. FLAC, which is open source, supports embedded metadata and typically reduces the original uncompressed file size by 50-60%. The only drawback for FLAC is Apple's iTunes does not support it.

PCM Uncompressed File Formats – Uncompressed file formats are exact copies of the original data. As such they take up more space than compressed formats. Some suggest, and I'm one of them, that the cost of storage has reached a point where the extra storage requirements and associated cost for uncompressed formats is negligible.

AIFF – Audio Interchange File Format (AIFF) is Apple's proprietary uncompressed file format.iTunes users interested in an uncompressed file format with embedded metadata choose AIFF since iTunes does not support FLAC.

FLAC (uncompressed) – Free Lossless Audio Codec (FLAC). The application dbPoweramp offers an option to rip or convert your music data to uncompressed FLAC format.

WAV – Waveform Audio File Format (WAVE or WAV) is another popular uncompressed format for music downloads developed by Microsoft and IBM. The one drawback for the WAV format is a lack of widespread support for its method of encoding metadata.

DSD – Direct Stream Digital brought to you by Sony and Philips originally for SACD uses pulse-density modulation (PDM) encoding to store analog signals. DSD is a 1-bit format with sample rates of 2.8224 MHz (also referred to single rate DSD and 64x DSD or 64 times CD's sample rate) and 5.6448 MHz (also known as double rate DSD and 128x DSD or 128 times the sample rate of CD) at present.

DSD file formats include DFF – Digital Interchange File Format (DFF), a DSD format that does not support embedded metadata and DSF – Direct Stream File (DSF), a DSD format that supports embedded metadata.

File types by bitrate and bit depth/sample rate & their associated storage requirements

FILE TYPE	STORAGE PER 1 MIN OF MUSIC (STEREO)	ALBUMS PER 1TB/STORAGE
128kbps	1 MB	20,900[1]
256kbps	2 MB	10,500[1]
320kbps	2.4 MB	8,700[1]
16-bit/44.1kHz (CD Quality)	10 MB	2,000[2]
16-bit/48kHz	11 MB	1,900[2]
24-bit/48kHz	16.5 MB	1,200[2]
24-bit/96kHz	33 MB	630[2]
24-bit/192kHz	66 MB	320[2]
DXD (24-bit/352.8kHz)	127 MB	165[2]
DSD64	42 MB	500[2]
DSD128	84 MB	250[2]

[1]Numbers are approximate and based on 45 minutes of **compressed music** per album.

[2]Numbers are approximate and based on 45 minutes of **uncompressed music** per album