

## Profiles and Levels

The H.264 specification defines several profiles and levels as part of the codec. Profiles and levels provide a set of agreed-upon guidelines between video content creators and the engineers developing players and playback devices on which video content will be played back. Profiles define which features of the codec are allowed, while levels define the value parameters for those features.

For example, most mobile phones support Baseline profile at Level 3. So when you create a preset for video to be played on a mobile phone, you must set Carbon Coder to Baseline profile at Level 3. Carbon Coder will then grey out all of the features shown in the UI, which are not allowed in Baseline profile, and set the maximum values allowed to all other parameters according to Level 3.

A full description of profiles, levels and their limits, as well as more information about H.264 in general, can be found at:

[http://en.wikipedia.org/wiki/H.264/MPEG-4\\_AVC](http://en.wikipedia.org/wiki/H.264/MPEG-4_AVC)

# Advanced H.264 Encoding with Carbon Coder

Achieving better video quality is often a trade-off with transcoding performance (i.e., the amount of time it takes to transcode). The presets that ship with Carbon Coder are designed for a balance between optimal quality and optimal performance. The recommendations in this guide will increase video quality at some cost to transcoding performance. Conversely, if performance is your main concern, you can configure your presets to the opposite of these recommendations.

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## To Load the Carbon Coder H.264 Preset

Download the CPF file:

[ftp://xfer:c4r60n@rhozet.harmonicinc.com/Presets/dst\\_H\\_264\\_HQ\\_SD.cpf](ftp://xfer:c4r60n@rhozet.harmonicinc.com/Presets/dst_H_264_HQ_SD.cpf)

Place the CPF file in one of the following two folders.

- **Windows XP or 2003**

C:\Documents and Settings\All Users\Application Data\Rhozet\  
Carbon Product Name\User Presets

- **Windows Vista, 7, or 2008**

C:\ProgramData\Rhozet\Carbon Product Name\User Presets

Next, start Carbon Coder, add a new target and, under the system category, you'll find a new preset called "H.264 High Quality SD."

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This guide is intended to help explain some of the advanced settings in the Rhozet Carbon Coder H.264 encoder. It also contains recommendations to maximize video quality for each setting.

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## To Access the H.264 Encoding Advanced Settings

These settings can be found by loading the H.264 preset in Carbon Coder and then clicking on Advanced.

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## Two New Filters to Increase Video Quality

In addition to new encoding parameters, Carbon 3.14 boasts two new video filters you can apply to source content to increase video quality.

The **Motion-Compensated Temporal Filter (MCTF)** is an advanced algorithm developed by Harmonic. Used in the award-winning Electra line of encoders, MCTF removes non-visible high frequency noise introduced mostly due to rapid motion in the source. With MCTF, you'll be able to get equivalent video quality at lower bitrates because the encoder is not compressing the high-frequency noise. This filter is most effective when the source has rapid motion, like a basketball game, and the target is low-bitrate, such as web or mobile output. The filter strength setting should be set higher for higher levels of motion. We recommend leaving the Motion Estimation set to Auto, to allow the filter to adaptively change as the source frames vary.

The **De-Blocking Filter** from Harmonic is also used in Electra encoders. The De-Blocking Filter should be used only if the source content contains blockiness due to previous digital compression. This filter smoothes the edges of blocks, softening the image but creating a more visually appealing output. It is particularly useful transcoding from interlaced source to progressive output. The filter strength should be raised for source content with more blockiness. It is important to note that this filter is applied before the compression, so it will not reduce blockiness introduced by the encode itself.

## Carbon Coder H.264 Advanced Encoding Settings

### Adaptive Quantization Strength

**Adaptive Quantization Strength - Brightness** – Specifies the strength of the quantization for Brightness. The available range is from -100 to 100 inclusive. A higher value indicates coarser quantization; lower values indicate finer values. The advantage to using finer values is most often realized in higher bitrates. For general use presets, this value should be left at 0 however, for specific types of source footage, this value can be adjusted higher or lower and typically requires a little "playing around with" to get just right.

**Adaptive Quantization Strength - Complexity** – Same as above

**Adaptive Quantization Strength - Contrast** – Same as above

### B-frames

**Reference B-Pictures** – Allows the encoder to use B-frames as a reference to build other frames. This also increases the efficiency of the encoder and should always be checked. Not available in Baseline profile.

**Use Adaptive B-frame Placement** – Allows the encoder to adaptively change the B-frame pattern based on the source content. This is very useful when you are using a longer GOP and trying to hit low bitrates. In general, this increases the encoder's efficiency and should always be checked. Not available in Baseline profile.

**Allow Pyramid B-frame Coding** – Allows the encoder to compress B-frames based on other B-frames. Like the above two settings this increases the efficiency of the encoder and should always be checked. Not available in Baseline profile.

### Black Normalization Level

Specifies the pre-encode black level. The default is 0; the available range from 0 to 32. So, for example, a broadcast source could be set to 16 if the blacks aren't being properly preserved.

### Deblocking

**Use Deblocking** – Turns the encoder's In-Loop Deblocking filter on and off. It is almost always recommended to enable this for distribution formats but not for post-production formats. Enabling this filter smoothes video frames and reduces the amount of perceived blockiness in the video at some cost to image sharpness.

**Use Adaptive Deblocking** – When enabled, specifies whether to use the deblocking filter with standard or alternative offsets related to the quantizer. Available values: 0 (standard offsets, default) and 1 (alternative offsets, which apply less deblocking for lower quantizers in order to keep more details in the encoded video). In general, we recommended enabling this setting.

**Deblocking Alpha** – Configures the Alpha strength of the In-Loop Deblocking filter. The accepted range is from -6 to +6, inclusive, with higher values yielding a stronger deblock. In general, -1 is a good recommended setting. If your output is still blocky you may increase this value to reduce blockiness at a loss to video sharpness.

**Deblocking Beta** – Configures the Beta strength of the In-Loop Deblocking filter. The accepted range is from -6 to +6, inclusive, with higher values yielding a stronger deblock. In general, -1 is a good recommended setting. If your output is still blocky you may increase this value to reduce blockiness at a loss to video sharpness.

## Denoise

**Denoise Strength Y** – Now automatically handled by the encoder, this is a legacy setting and should be left set to 0.

**Denoise Strength C** – Now automatically handled by the encoder, this is a legacy setting and should be left set to 0.

## Entropy Encoding Mode

There are two options: **Context-Adaptive Variable Length Coding (CAVLC)** and **Context-Adaptive Binary Arithmetic Coding (CABAC)**. Without going into how these two different algorithms work, here's when it's appropriate to use one or the other... First, CABAC is not supported in baseline profile, so if you're using baseline, you must choose CAVLC. Second, it's important to know that CABAC will almost always produce better quality results than CAVLC, but requires much more processing power to decode. A general rule-of-thumb is to use CAVLC for hardware playback devices and CABAC for software based playback.

## Fast

**Use Fast Inter and Intra Decisions** – This is a mode for the encoder to trade off transcoding speed for video quality. For quality, this should always be disabled.

**Use Fast Multi-Reference Frame Motion Estimation** – Same as above

**Use Fast Sub-Block Motion Estimation** – Same as above

## GOP and IDR

**GOP Size** – “GOP” is the abbreviation for Group of Pictures; “GOP Size” defines the distance between IDR (Instantaneous Decoding Refresh) key frames. Often the intended playback device will mandate a value, but a good general recommendation for hardware devices such as phones or set-top boxes is double the frame rate. For software playback such as Flash or QuickTime players, 3 to 5 times the frame rate is very common.

**Minimum GOP Size** – Defines the minimum distance between IDR frames. This setting is used in conjunction with **Enable Scene Change Detection**, which can create non-uniform GOP sizes. This value should be set to 1 unless a specific device requires a different value.

**IDR Frequency** – Defines how often I-frames are marked as IDR frames. An IDR frame is a special type of I-frame in H.264. An IDR frame specifies that no frame after the IDR frame can reference any frame before it. This makes seeking the H.264 file easier and more responsive in the player. Unless the target playback device requires a different value, this setting should also be set to 1 (every I-frame is an IDR frame).

## Grain Optimization Strength

We recommend using higher strengths for very grainy or noisy material and lower strengths for less grainy material. Available range is from 0 (off) to 100; default value is 0. It is recommended to leave this at 0 unless the footage is grainy and, if so, to increase it to the appropriate level to compensate for the amount of film grain in the source. Alternatively, for creating “all-purpose” presets, you can leave it set to 50. This will improve perceived video quality at some cost to PSNR.

## Hadamard Transformation

**Use Hadamard Transformation** – This is an algorithm named for mathematician Jacques Solomon Hadamard, which calculates two discrete Fourier transforms (DFTs). For increased quality this should always be checked.

## HRD

**Maintain HRD** – This is purely for device compatibility. It is recommended to leave it off unless encoding for a device that requires it, such as BluRay.

## *MBAFF (Macro-Block-Adaptive Field/Frame coding)*

This setting is only applicable for transcoding from interlaced to interlaced frames, in which case this setting should always be turned on. The video quality will always be better, but it will slightly increase the transcode time.

## About Rhozet

Since 2004, Rhozet, a business unit of Harmonic Inc, has focused on designing scalable, high-performance, universal media transcoding technology for delivering content in any format, at any time, on any device, smoothly, efficiently and in the most cost-effective manner possible. Rhozet began as part of Canopus and operated as an independent company from 2005 until August 2007, when Rhozet was acquired by Harmonic, a manufacturer of enterprise-class hardware encoders. In addition to its enterprise trans-coding products, Carbon Coder and Carbon Server, Rhozet is the developer of the popular desktop transcoding applications ProCoder and ProCoder Express, which have been marketed and sold under the Grass Valley brand since its acquisition of Canopus.

## Motion Estimation Subpixel Mode

Indicates the depth of the pixel examined for motion estimation. Quarter pixel will yield the highest video quality but the slowest transcode time. Moving to half and finally full pixel will decrease video quality but transcode much faster.

## Number of Slices Per Picture

Defines the number of horizontal segments (slices) into which the frame is divided for encoding. Increasing this value can potentially speed up the transcode process with some cost to video quality. For most applications this should be set to 1. Some applications specify the number of slices to use (such as BluRay, for which this must be set to 4).

## Reference Frames

Defines the number of reference frames used during encoding. Reference frames are previously-encoded frames which the encoder uses while executing the motion search algorithm for B and P frames. More reference frames will create higher quality output but will also increase transcoding time and the memory requirement for decoding. This value can be set from 2 to 16 frames. A good general value is 4, and should be increased to target transcodes at lower bitrates.

## Search Shape

This is the macro-block search mode and can be set to 8x8 pixels or 16x16 pixels. 8x8 will be a slower transcode but yield higher quality. Conversely, 16x16 will be a faster transcode at a lower quality level. If transcoding speed isn't your main concern, this should always be set to 8x8.

## Weighted Modes

**Use Weighted P Mode** – Allows the encoder to use weighted prediction for P-Frames. This is used mostly to compensate for camera flashes or fades. We recommend enabling this feature for quality.

**Use Weighted B Mode** – Not enabled yet, but ditto for the above.