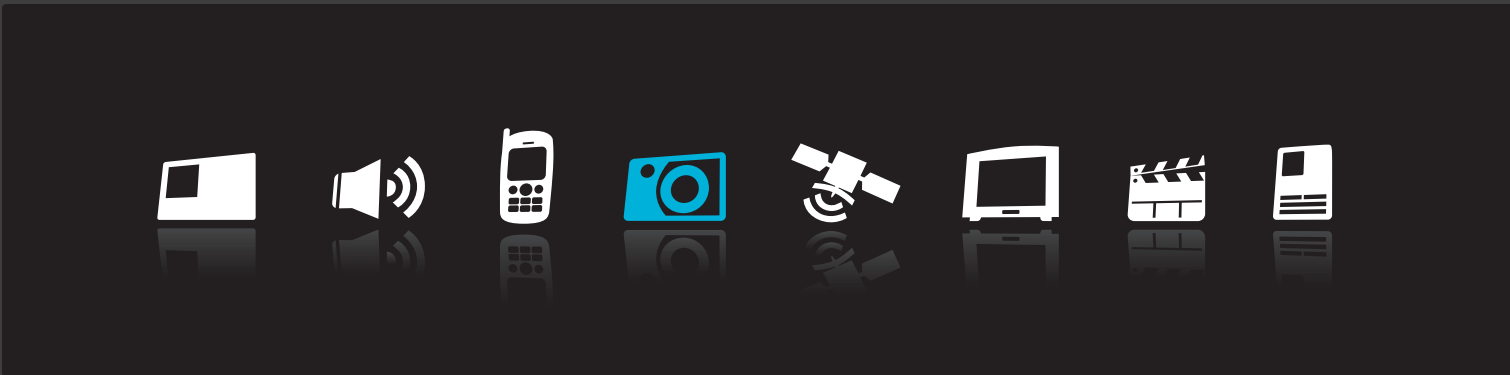




# Digimarc for Images

Best Practices Guide (Chroma + Classic Edition)



## Best Practices Guide (Chroma + Classic Edition)

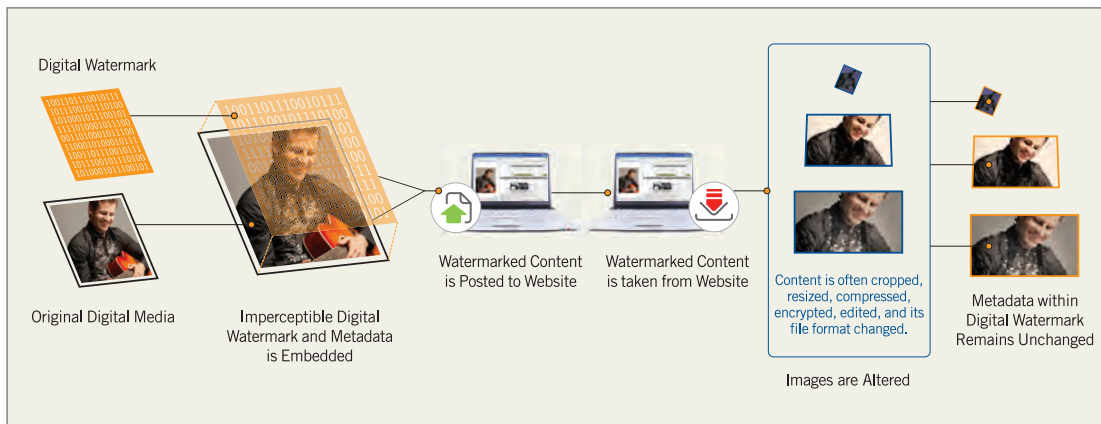
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# Best Practices Guide

## Why should you digitally watermark your images?

In today's digital world, as more and more images appear online and are rapidly circulated across the Internet, it is not unusual for the people who create and license digital images to lose control over the process of distribution; it is also common for them to be unaware of where their images may be appearing and how they are being used.

To help protect and manage valuable image assets, it is essential to be able to communicate ownership of these images and determine where they are being used – with or without the consent of the content owner. This is what Digimarc® for Images offers to image owners. By embedding an imperceptible digital watermark into images prior to posting or distribution, users ensure their images will carry a persistent digital ID that will always link back to the owner. Unlike standard metadata that is often stripped from a file, digital watermarks will stay with images as they are manipulated, copied and transformed from one file format to another. Also, the unique digital ID in every Digimarc for Images watermark allows for images to be searched and found as they travel across the Internet.



## What types of images can be digitally watermarked?

Virtually all images can be digitally watermarked; however, some types will yield better results than others, as will be discussed in this guide. We will provide you with information on all aspects of digital watermarking to ensure you are able to obtain the best results from using this powerful technology.

### Bitmap images vs. vector images

Digital watermarking works with images in a bitmapped format, which can be either color or grayscale.



Vector or line-art images can also be digitally watermarked as long as they are first converted to a raster or bitmapped format.

## Color space

The embedding process places a digital watermark in either the chrominance or luminance component of an image. Users of digital watermarking technology now have two options depending on what is being watermarked: A Chroma watermark, which is generally preferable for color images, uses the chrominance (color) of an image to embed a digital watermark. Digimarc's Classic watermarking technology, now used primarily for grayscale images, uses the luminance data of an image to embed the watermark.



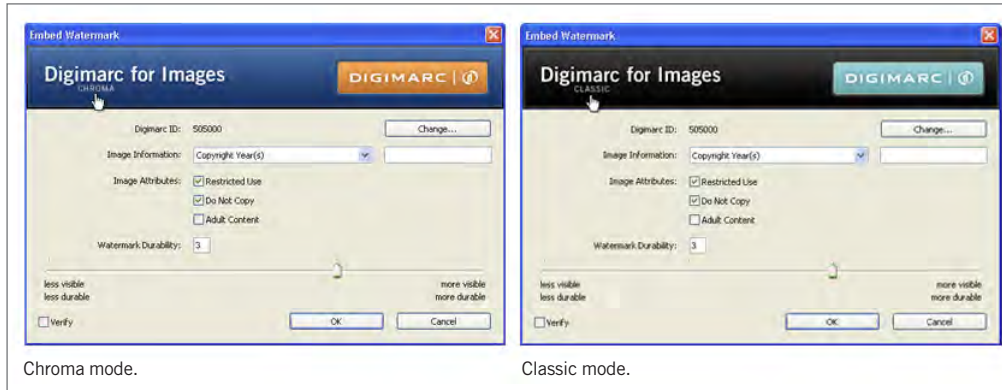
The Chroma watermark works with RGB and CMYK images only and remains retrievable over a much greater range of scaling and compression when compared to a Classic watermark. Additionally, Chroma watermarks will survive when being converted from RGB to CMYK, or vice-versa.



A Classic watermark can be placed in RGB images, as well as CMYK, LAB or grayscale images, and will survive when an image is converted from one color space to another.

Your embedder will automatically select the Chroma digital watermarking mode when watermarking RGB and CMYK images. The user can configure the embedder to embed Classic digital watermarks at any time, if desired.

When using the Digimarc for Images Adobe® Photoshop® plug-in the top banner will change when you switch from the default Chroma mode into Classic mode. To switch modes you need to simultaneously select the Ctrl/Alt/E key (PC) or the Cmd/Opt/E key (Mac).



Chroma mode.

Classic mode.

**NOTE:**

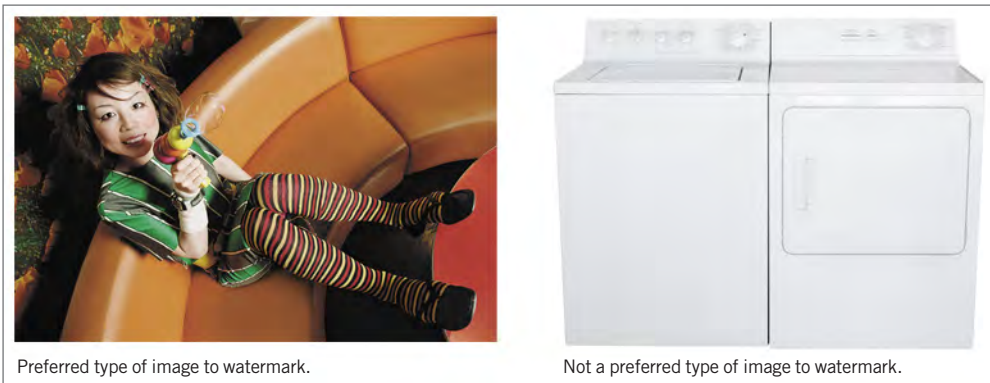
*Clicking on the banner will take you to the Digimarc for Images website.*

**File formats**

A digital watermark is woven into and carried by the pixels that make up an image and survives even when the image is converted from one file format to another. Refer to the User's Guide of your product for specific information regarding file formats supported by your embedding application.

**Image variations/randomness**

Digital watermarks are most effective and least perceptible when applied to images that are not composed, mostly or entirely, of a single flat color. Rather, images that contain some degree of variation or randomness will yield better results.



Preferred type of image to watermark.

Not a preferred type of image to watermark.

Digimarc uses a patented technique called “perceptual adaptation” when embedding digital watermarks as a means to make the watermarks as imperceptible to viewers as possible. When embedding with the Classic watermark, the software identifies areas of the image that are highly detailed or very flat and adjusts the intensity of the digital watermark accordingly. In flat areas the digital watermark intensity is decreased, while in detailed regions the intensity is increased. If an image is composed mostly of flat areas, it may be difficult to ensure the digital watermark is truly imperceptible. When embedding with the Chroma watermark, the software identifies specific regions and increases or decreases the intensity of the watermark depending on the color and tone of that region.


## Image size recommendations

To embed a digital watermark into an image, and be able to reliably read it later, digital watermarks require a minimum number of pixels with which to work.

 Digimarc recommends a minimum size of 256 x 256 pixels. There is no upper limit on image size for digital watermarking.


### NOTE:

*You may find that some smaller images actually watermark successfully, where some larger images do not. This is likely due to the variation/randomness of the image (as discussed in the previous section), the durability setting used when embedding the watermark (see “Using the ‘watermark durability’ setting”), and the parameters used in applying compression, if any (see “Factors affecting the durability of a digital watermark”).*

 If you are going to watermark images smaller than 256 x 256 pixels, it is recommended that you use a Classic watermark to improve the detection.

## Image workflow overview

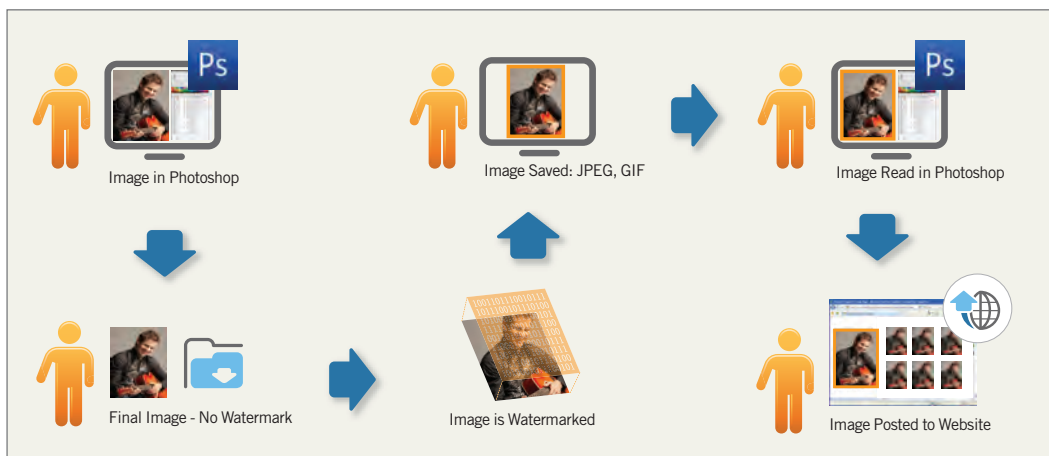
As you prepare an image for final use, you may take it through a number of different transformations. You might save the image in multiple resolutions, and perform a number of edits as discussed in the “Survivability of a watermark” section of this Guide, such as scaling, cropping, rotation, etc.

 Digital watermarking should be one of the very last processes you apply to your image, with the exception of compression.

## Where and when to digitally watermark images in your process

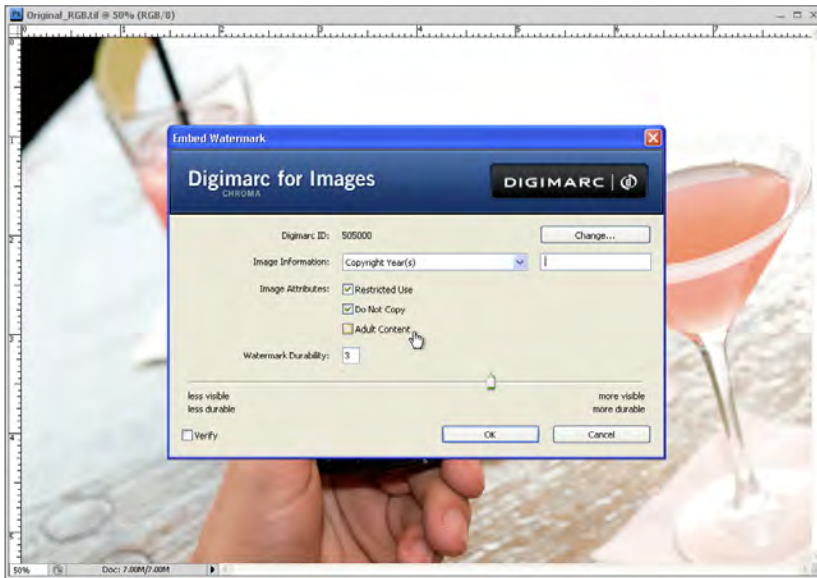
The recommended workflow sequence for digital watermarking is as follows:

1. Make all necessary modifications to your image until it has the desired final appearance.
2. Save a final unmarked copy since you cannot embed a watermark in an image that already contains one.
3. Embed the digital watermark.
4. If the final image should be compressed, compress by converting to JPEG or GIF format.
5. Read the digital watermark after compression to verify it was successful. For Photoshop users this may require closing and reopening the watermarked image.
6. Publish the image.



## Setting digital watermark attributes

When you're ready to embed a digital watermark, you will need to set a number of parameters for the information the watermark will contain. The following list summarizes these attributes.



- **Digimarc ID.** A unique number, which you receive upon registration, that identifies you with Digimarc as an image creator. This unique ID is linked to the creator's contact information within our registry.
- **PIN.** A Personal Identification Number provided to you by Digimarc for use in validating your Digimarc ID when you key your Digimarc ID into the Digimarc watermark embedding software.
- **Copyright Year.** This can be a single year or range between two years, i.e. 2005-2010.
- **Image or Transaction ID.** A unique number that you assign to identify the image or transaction (range for either ID is from 1 to 4,294,967,296).
- **Restricted Use.** When selected, this indicates that the image is copyrighted and subject to restricted use.
- **Do Not Copy.** When selected, this indicates the image's creator and/or distributor has specified that the image should not be copied without permission.
- **Adult Content.** When selected, this indicates the image contains Adult Content.

## Digital watermark strength

Digimarc's solution is designed to embed digital watermarks that are both imperceptible to the human eye and persist with your image regardless of what happens to it or where it may travel. This can be a delicate balancing act, since the durability and visibility of a digital watermark are directly related. An increase in watermark durability, or robustness, increases the strength—and may, in some cases, increase the visibility of the watermark.

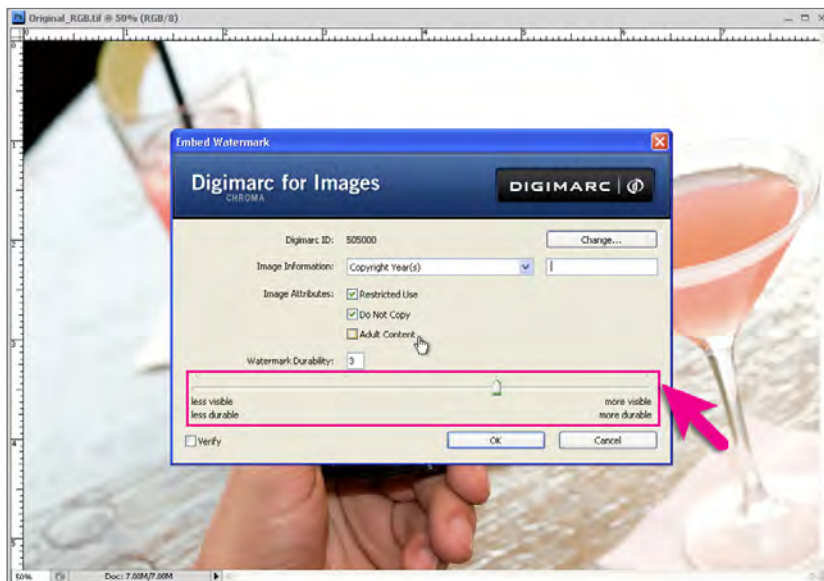


**NOTE:**

*For color images, the Chroma watermark has proven to be superior in this area. The Chroma watermark remains imperceptible while providing a highly robust watermark that persists with the image. Digimarc recommends using this default setting in the majority of your color images.*


## Using the “watermark durability” setting

The default watermark intensity setting found in Digimarc for Images has been chosen to strike a balance between digital watermark robustness and visibility in the majority of images. However, this setting is by no means “one size fits all.” Digimarc provides controls so that you can increase or decrease the watermark intensity level yourself to achieve the desired balance between watermark robustness and visibility in your digital watermarking projects.



Digimarc provides controls so that you can increase or decrease the watermark intensity level yourself.

The setting you select will depend on the intended use of the image and on the goals you've set for your digital watermarks. For example, it may be quite acceptable to use a higher watermark durability setting with JPEG images posted on a website. The higher durability helps to assure the persistence of the digital watermark, and the increased visibility will most likely not be noticeable with medium-resolution JPEG images.

 Digimarc recommends that you try various digital watermark intensity settings as part of your testing process to see which setting works best for your images. The goal is to find the balance between visibility and durability that meets your needs.

## Factors affecting the durability of a digital watermark

As mentioned earlier, a digital watermark is designed to be robust and survive typical image edits and file format conversions. This section provides details on the many factors that can affect the durability of a digital watermark and includes tips for obtaining optimum results when embedding your digital watermarks.



## Image compression

In general, a digital watermark will survive image compression, but the survival is dependent on several factors. Lossless compression, such as LZW, StuffIt™ and the .ZIP format, does not affect the survival of a digital watermark at all because no image data is sacrificed to create the compressed version. Lossy compression methods such as JPEG or indexed color formats actually remove image data in order to decrease file size; this can affect a digital watermark's durability. The following factors influence the impact that lossy compression has:

- Level of image compression: Lossy compression degrades the image to some extent, depending upon the quality setting chosen when saving in compressed format; most digital watermarks will survive as long as a moderate level of compression is used (see the next section for more detail).
- Visibility/durability setting used when embedding a digital watermark: The higher the durability setting, the better the chances the digital watermark will survive compression. The visual quality of compressed images is somewhat compromised so often a higher watermark durability setting is less noticeable.
- Image size: The greater the number of pixels in the image, the more the digital watermark can be repeated throughout it; the recommended minimum size for an image that will be compressed is 256 x 256 pixels. The larger the image, the better the digital watermark will survive compression.
- Randomness of image data: Discussed previously in the section “Image variations/randomness.”

## JPEG compression guidelines

Images vary so widely in their detail, randomness and other qualities that it is impossible to provide universal guidelines for applying compression to all images. A digital watermark in one image may survive a compression ratio of 20:1, while another may not survive anything more than 10:1. In addition, image editing applications vary widely in how they apply compression as well as how they present the available compression options to the user. For example, one application may offer a compression scale of “Low,” “Medium,” “High” and “Maximum” image quality, while another may provide a numerical scale of 0 through 255. As a result of these inconsistencies, it is challenging to provide specific recommendations for which compression settings you should use with your watermarked images.

Your objectives for using a watermark should help determine how robust you want the watermark to be within your images.


When using the watermark as a component of an internal Digital Asset Management (DAM) solution or tracking images that are smaller than 256 x 256 pixels (i.e. unlikely to be resized smaller by another user), you should find that using the default watermark strength setting and a JPEG quality setting of 50 is reliable for detection. As mentioned previously JPEG compression scales vary, so a setting that yields no more than a 10:1 reduction in file size from your originals should ensure watermark survival in most images.




If you are using the watermark to track images on the Web that are larger than 256 x 256 pixels, Digimarc recommends using the default watermarking strength as a minimum setting and a JPEG quality setting of at least 80, or greater, to significantly improve the probability of detecting the watermark. The image quality settings referred to are from Adobe® Photoshop® using the “Save for Web and Devices” option.

## GIF and indexed color formats

If you primarily work with GIF images, you are already accustomed to reducing the color depth of an image in order to decrease its file size and accelerate its loading speed for Web use.

 When the image you're working with is to be digitally watermarked and saved as an indexed color format, Digimarc recommends you begin the process with the image already indexed.

In Photoshop, no filters are available when working with indexed-color images such as the GIF format. This will prevent you from using the plug-in filter to embed a digital watermark in such an image. The solution is to convert the image to RGB, apply the digital watermark, and then convert it back to indexed color using 256 colors and the local adaptive palette.

 You should be aware that if you repeatedly change the image's color palette (decrease the number of colors, or change colors in the palette itself) after the digital watermark has been embedded, this might decrease the durability of the digital watermark, as well as the quality of the image.

## Guideline for all lossy compressed images


Lossy compression is not usually applied to an image until it is written to disk. This means that in order to properly confirm the watermark strength you must open the final compressed file that was written to disk. This will always be true if you used a "Save As" option. If it was saved as an indexed format you will need to also convert the image back to RGB so the Read Watermark filter (in Photoshop) will be available for testing.

## DPI settings

When digitally watermarking an image for use on the Internet, resample the image to the proper DPI setting for this medium (either 72 or 100 DPI) before you embed the digital watermark. Correctly matching the digital watermark's DPI setting to the image's final resolution will optimize the durability of your embedded information.

## Resampling images

In some situations, you may wish to have multiple copies of an image at different sizes. For example, a small preview image is often used to link to a larger image for viewing.

 When you are working with an image that you will be resampling to multiple sizes, always resample before embedding a digital watermark.

This means conducting more digital watermarking operations than if you embedded only once prior to resampling, but your digital watermarks will be much more durable using this approach.

## Survivability of a watermark

The previously mentioned factors that affect the durability of a watermark directly influence survivability of watermarks; image variation, watermark durability settings and lossy compression. Survivability results will vary.

## Scaling

The original image that was digitally watermarked can generally survive being resized. **Chroma mode watermarking typically survives being sized up to 200% or resized down to 25% of the original size, and in many cases even lower. Classic mode watermarked images should be readable after being sized up to 200% or scaled down to 60% of the original.**

## Cropping

Because the digital watermark is repeated throughout the image, removing portions of the image by cropping will generally not affect the watermark, provided that the final image meets or exceeds the minimum size discussed above.

 **If the image is cropped to less than 256 x 256 pixels, the watermark may not survive.**

## Rotation


Unlike other systems that embed copyright information in images, a Digimarc watermark remains intact when the image is rotated by any number of degrees. The rotation can be as small as 1 or 2 degrees or as large as the most extreme arbitrary rotation, with no affect on watermark survival.

## Effects filters

The general rule is that the survival of the digital watermark is linked to the visual quality of the image. If an effects filter is applied at an extreme setting such that the quality of the image is compromised (particularly distortion-type effects such as Blur, Twirl and Morph), then it is possible the digital watermark may no longer be readable from the image.


## Working with layered images

When working with an image that contains multiple layers, watermarking the image in that state would apply the digital watermark only to the selected layer, rather than to the entire image.

 **We recommend saving a separate copy of the layered file, then flattening the image before applying your watermark.**

## Combining digital watermarks with visual watermarks

When creating digital comps for an agency or prospective customer to review, you may want to apply a visual watermark in addition to a digital watermark to prevent their use in a final piece. If you decide to use a visual watermark, be sure to apply the digital watermark last. If done in the reverse order, the visual watermark could possibly disrupt a significant number of pixels, changing the image drastically, thus impacting the digital watermark.

 **When applying a digital watermark to a comp, you can use a higher-than-usual durability setting if you like because some degree of image variation is acceptable in this situation.**

## When to switch from Chroma to Classic watermarks

Digimarc recommends Chroma watermarks for all color images. The improved visual quality and durability especially after scaling and JPEG compression are significantly better. In most instances, the default Chroma setting will yield the best results; however, there are some situations where you may want to switch to the Classic watermark. These are described below:

- **If you are watermarking images smaller than the recommended 256 x 256 pixels, the Classic watermark will likely give you the best results.** When watermarking images smaller than 256 x 256 pixels, you should also consider increasing the durability setting to help with detection.
- Grayscale, also known as black and white, images have no chrominance so the Chroma embedder is unable to watermark them. **Your embedder will automatically switch to Classic mode for all grayscale images.**

Depending on the type of images you are watermarking you may find the visual artifacts of the Chroma watermarking mode to be more obtrusive than the Classic mode. Your embedder software has the ability to switch between modes based on user preferences.

## Comparing the Classic and Chroma modes visually

Some users will wish to explore the visual differences between Classic and Chroma in depth. This may involve enlarging watermarked images on screen, checking individual channels, displaying before and after images, and side-by-side comparisons of the Classic and Chroma technologies.

This level of detail can be informative, but it does not accurately represent the final digitally watermarked image. Digimarc recommends viewing the final watermarked image on screen at 100% to gauge watermark imperceptibility.

While developing Chroma watermarking, thousands of images were reviewed and, in some cases, it was possible to notice some visible artifacts of a Chroma watermark. This generally occurred when reviewing the images outside their final intended usage, such as:

1. When reviewing the individual channels users may notice that the blue channel in RGB mode (yellow in CMYK) has more watermark artifacts when embedded with Chroma than with Classic.
2. Some users may notice that when viewing certain images at 200% or larger that Chroma artifacts might seem to be more apparent than the Classic artifacts.

The blue channel artifacts would only be an issue if you planned to post just a blue channel image. The general nature of magnifying an image can reveal any artifact. Please refer to our workflow recommendation that all images be watermarked at their final size to avoid any visual scaling issue.

Digimarc is continually striving to advance digital watermarking technology. We believe the addition of the Chroma watermarking mode with its visual improvements and improved robustness, especially surviving scaling down to 25% or smaller from an original image, continues this tradition of innovation.

## Additional Resources



### Digimarc for Images Blog

[blog.digimarc.com/images](http://blog.digimarc.com/images)

Your source for entertaining and informative discussion of digital watermarking for digital images.



### Digimarc Videos

[www.digimarc.com/video](http://www.digimarc.com/video)

Directory of informative videos designed to educate and demonstrate Digimarc's innovative technology and solutions.


### Introduction to Digimarc's new Chroma digital watermarking technology

[www.digimarc.com/chroma](http://www.digimarc.com/chroma)



**Ben Bounketh**  
Product Manager @ Digimarc

Digimarc's newest digital watermarking technology for images is introduced and compared to our original Classic technology. For on-screen comparison purposes, images used in the video are available for download: [www.digimarc.com/chroma](http://www.digimarc.com/chroma).



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