

Pixels vs. Resolution

Documentation

Pixels vs. Resolution

There is still major confusion. What do these terms actually mean? And how do you achieve the best possible presentation, both online and on printed material.

What is a pixel?

Every digital image, whether it is a photo or a scanned image, is constructed of colored points (pixels).

These pixels can display over 16 million colors. All devices that process or display digital images operate based on these image points. For the sensor of a camera and for screens (phone, monitor, television, beamer) the number of pixels is used to indicate the resolution or the amount of detail in the recording or display.

In the specification of the concerned devices, the number of pixels can be found under the term 'resolution'.

For example, a sensor with 10 million pixels has a resolution of 3888 x 2592 pixels, the resolution of a computer screen is 1280 x 1024 and the screen of a full HD television is described as 1920 x 1080 pixels. These days there are also full HD computer screens.

Resolution

When we print pictures on printed material, the term resolution is being used. When being told that 300 dpi is the optimal quality for printing with a size of 15 x 10 cm, 300 pixels are being used per 2,54 cm to print the photo. Pixels are linked to the length unit.

For printing 1 cm of a photo, 115 pixels are needed (=300 pixels per inch = 300 dpi). A picture of 10 x 8 cm contains 1,1 million pixels (1150 x 920 pixels), an A5 contains 4,1 million pixels and an A4 8,2 million pixels.

How do we know how big a printing can be if we use a digital photo of say 3888 x 2592 pixels? We can calculate this using the print resolution.

When we want to print said picture of 3888 x 2592 pixels (10 Mp) with 300 dpi, we need 300 pixels to print 2,54 cm.

With 3888 pixels the width will then be $(3888/300) \times 2,54 = 32,9$ cm and the height with 2592 pixels will be 21,9 cm. A print of roughly 30 x 20 cm, about A4.

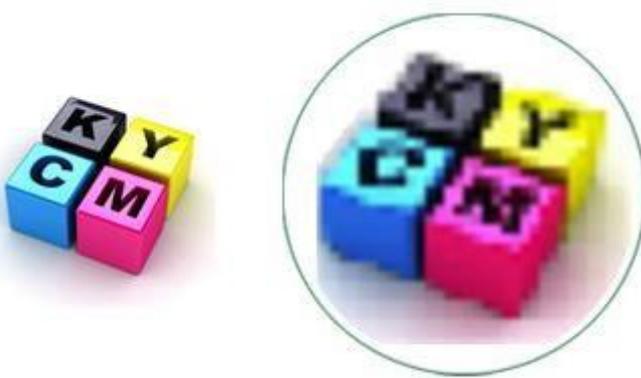
With the same 3888 pixels, but with 100 dpi, the width will be $(3888/100) \times 2,54 = 98,8$ cm and the height with 2592 pixels will be 65,8 cm. A print of roughly 98 x 65 cm, so minimal A1.

An example: You see a nice image on the internet and you would like to use it in your brochure.

Internet

For a screen and the internet 28 pixels per cm are needed (=72 pixels per inch = 72 dpi). For displaying pictures on the internet there is no indication for a set size or image ratio. Most internet users have a monitor with 1024 x 768 pixels. If you want to display a picture on half of the screen width, a width of 500 pixels is a nice size. If someone is using a screen with 1920 x 1080 pixels, the same picture will only cover a quarter of the screen width.

An image on the internet of 10 x 10 cm (72 dpi) needs to be edited before it may be used for printing. For this you need to multiply or divide 72 dpi to get 300 dpi (300 divided by 72 = 4,17). If you multiply the resolution in dpi, you have to divide the size of the image by 4,17 (10 x 10 cm divided by 4,17 = 2,4 cm squared). This means that the image you found on the internet and want to use for printing will not be 10 x 10 cm, but after the right adjustments only 2,4 x 2,4 cm. So although 300 dpi, only the size of a stamp.



When an image from the internet (image on the left) is taken to be used for printing, the image (when keeping the same size) will be blurry and of very poor quality (image on the right).

Printing

In practice we print photos with 300 dpi (remember, for a 1 cm photo 115 pixels are needed). Sometimes a lower print resolution may be more practical.

First, there is the viewing distance. The greater the viewing distance to the printout, the lower the resolution may be.

A photo of 15 x 10 cm looked at from half an arm's length, needs 300 dpi for maximum visual acuity.

A printout on A4 is often looked at from a full arm's length, in which case 200 dpi will already be sufficient.

On a billboard along the highway only 32 dots per inch (32 dpi) are being used and still the image is quite sharp from 20 meters distance.

Small and medium print formats

Print format in cm	9 x 13	10 x 15	13 x 18	15 x 21	20 x 30
Pixel format for 300 dpi	1062 x 1499	1204 x 1794	1499 x 2100	1794 x 2549	2396 x 3599
Pixel format for 200 dpi	708x 999	802 x 1196	999 x 1400	1196 x 1699	1597 x 2132
Pixel format for 100 dpi	531 x 749	602 x 897	749 x 1050	897 x 1274	1198 x 1599

Photo poster

Print format in cm	30 x 40	40 x 54	50 x 67	76 x 101
Pixel format for 200 dpi	2400 x 3543	3200 x 4250	4000 x 5330	6000 x 8000
Pixel format for 150 dpi	1800 x 2400	2400 x 3200	3000 x 4000	4500 x 6000

The estimated quality

The next two tables show the maximum photo resolution of your photos, depending on the focus and quality of your photo equipment, with the possible corresponding print format.

Small and medium print formats

To achieve a good quality for your printouts, the number of dpi needs to reach 300. We discourage you to use a photo resolution lower than 200 dpi.

Number of pixels	Maximum resolution in pixels	Estimated print quality per format				
		9x13 10x13	10x15 11x15	13x17 13x18	15x20 15x21	20x27 20x30
1 Mpx	1280 x 1024					
2 Mpx	1600 x 1200					
3 Mpx	2048 x 1536					
4 Mpx	2280 x 1700					
5 Mpx	2580 x 1940					

-  Very good > 300dpi
-  Good > 200dpi
-  Discouraged < 200dpi

Photo poster print formats

Number of pixels	Maximum resolution in pixels	Estimated print quality per format			
		30x40 30x45	40x54 40x60	50x67 50x75	76x101 76x115
3 Mpx	2048 x 1536				
4 Mpx	2280 x 1700				
5 Mpx	2580 x 1940				
6 Mpx	3000 x 2000				
7 Mpx	3200 x 2187				
8 Mpx	3450 x 2325				
9 Mpx	3672 x 2450				

Small, medium and large posters:		Very good > 120 dpi		Good < 120 dpi
Extra large posters:		Very good > 90dpi		Good < 90 dpi