

PRINTING DIGITAL IMAGES

Users of digital cameras have a number of ways of obtaining prints from their digital files. Many amateur users will take their memory cards, (and CDs or memory sticks) into camera shops and other retail outlets, and obtain sets of prints very quickly and economically, produced by processing machines housed in-store. These machines will apply automatic settings to produce photographic quality, colour balanced prints.

Prints can also be obtained via the internet by uploading the images to one of a number of specialist printing web sites. The prints are then sent back to you by post.

You can also take the memory card from the camera to a kiosk found increasingly in camera shops, supermarkets and even motorway service stations, and make your own prints by following the on-screen menus. It is possible to zoom, crop, and even remove red eye in some cases. Some of these machines can also produce CD backups from you memory cards.

However, it has never been easier to produce your own prints at home, using ink jet or thermal dye sublimation printers. These technologies are capable of producing results that easily match traditional photographic printing. Many home printers today can print images straight from the camera memory card, particularly those cameras with the PictBridge facility. This allows users to “tag” those images selected for printing. Costs of home printing can be greater than printing in-store.

Ink Jet Printers

Ink jet printers generally use four ink cartridges, each filled with cyan, magenta, yellow and black ink, though the “photo” models, introduced specifically for the

printing of “photographic quality” images, usually use five coloured inks: cyan magenta, yellow, light cyan and light magenta, plus black. The addition of the pastel coloured inks allows much finer tonal gradations on areas such as skin tones and graduated backgrounds.

The cartridge contains liquid ink which is forced into a tiny nozzle, either by the application of heat or pressure. Several manufacturers use a thermal technology, whereby the specially formulated ink is heated rapidly in a tiny chamber in the print head, where it forms a tiny bubble at the end of the nozzle, hence the common name of “bubble jet” printers. The size of the droplets is minute - they can be many times smaller than the width of a human hair. For example, the size of ink droplets with some printers varies between 3 and 6 picolitres (1 picolitre = 0.000 000 000 001 litre!) The ink is ejected through microscopic nozzles onto the paper.

Another major system uses “piezo-electric technology” instead of the heat process. Piezo crystals control tiny pumps which can fire the ink droplets at the paper with high speed and great accuracy (piezo crystals oscillate, and change their shape when a voltage is applied - this piezoelectric effect is used in various devices such as crystal microphones and strain gauges). The shape, size and sharpness of each dot can be determined with great accuracy – some models can produce up to 6 different droplet sizes.

Inks have improved enormously recently, with new versions being quick drying, meaning less spreading as they hit the surface of the paper, leading to sharper images. Pigment - based inks rather than dye – based inks are also becoming increasingly common – these are usually much more resistant to fading.

All ink jet printers work best with dedicated paper types, as the absorbency of the paper controls the brightness and definition of the image. It is worthwhile testing several different paper types and surfaces, as surprising differences in quality will be found, even between two “photo quality glossy papers” for example. Even the base white may vary from one manufacturer to another, leading to colour changes in the images. It is important to read the recommendations supplied with

the paper regarding printer settings, as these will govern the amount of ink put on to the paper.

Too much ink will lead to “bronzing” for example, where shadow areas may exhibit a metallic sheen where the ink has not been absorbed by the paper. Ink jet papers are made in a wide range of surfaces such as watercolour, canvas and satin, and several are available as double sided papers. It is possible to use good quality “art” paper for exhibition purposes, and experimentation is worthwhile.

The two major issues with printing are those of colour management – how to get the best colour from your images, and of resolution – how big do your images need to be?

Thermal dye sublimation printers

This method of printing uses a system of transferring dye from magenta, yellow, cyan and, in some machines, black ribbon onto a paper surface. A heating element the width of the paper vaporises (sublimation) the dye on the donor ribbon surface which is then absorbed into the surface of the paper. The image is generated by applying three or four passes of the donor ribbon to a single sheet of paper. The registration of the paper is crucial to the quality of the final image. As this dye is transparent each pixel on the page can represent any color by varying the amount of the three or four colours. The action of the dye in being absorbed into the paper also means that the individual pixels join together to form a seamless area of colour similar to a true photographic print. Many models have an ultraviolet absorbing filter which is applied to the paper surface to reduce fading. These printers are capable of very rapid printing times (under a minute in some cases) and are being used increasingly by professional photographers for social functions.

Colour

Probably the biggest problem when trying to print digital images is matching the printed output to the image displayed on the computer monitor. The fact that this is not always easy is perhaps not too surprising! The image on a monitor is in the

form of glowing phosphor dots, whilst a printed image is in the form of ink or dye on paper, and is viewed by reflected light.

The first step is to “calibrate” your monitor. Some programs, such as Adobe Photoshop, come with a monitor calibration facility (such as Adobe Gamma), but for most accurate results it is worth considering a monitor calibration device.

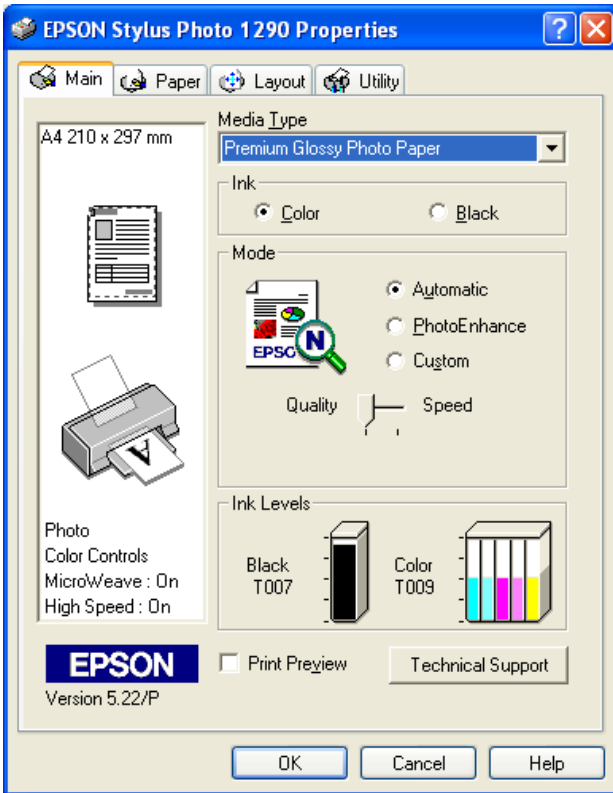
These act like a light meter, measuring the actual densities and colours on your screen, and producing a “profile” of your monitor so that it appears the same as other calibrated monitors. It is important to set up the lighting in the room where the monitor is situated so that the amount of ambient light falling on the screen is constant. It may be worth constructing a hood from black card to fit around the monitor to exclude ambient light. Ensure the monitor has been on for 30 minutes or so before calibration. For imaging purposes, make sure that the desktop pattern is a neutral (boring!) grey colour, which does not conflict with the colours in the image.

With the monitor set, produce a print, and then compare this with the monitor. With luck it will not be too far away from the monitor display, and enable you to predict .

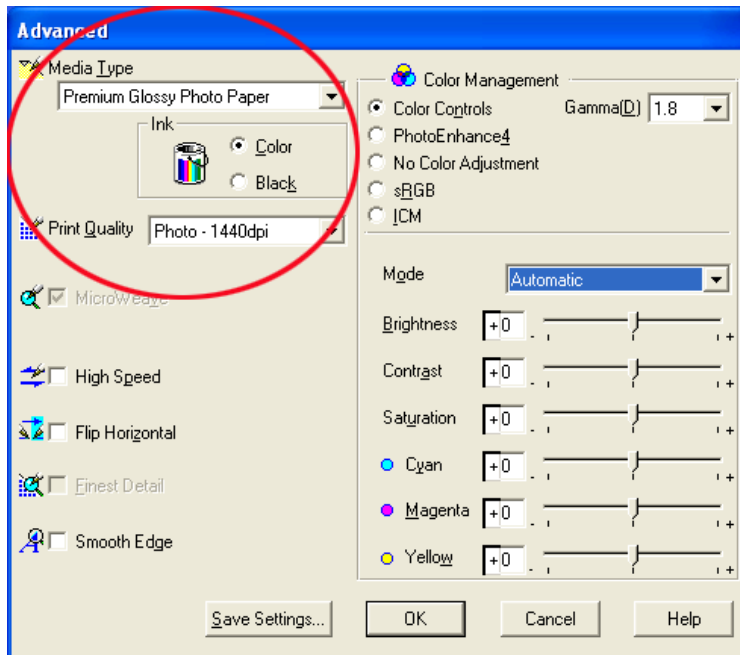
If the print is too dark or too light, or the wrong colour, then adjust the image in the software, and produce another print. Two or three test prints should be sufficient to achieve a result close to the monitor display, and importantly, which can be predicted consistently. Several manufacturers make devices and aids to help colour balancing, which are well worth the investment. Several companies offer a “printer profiling” service, whereby they measure the densities of colours and tones printed on your actual printer, then produce a profile of your printer/paper/ink combination, which can be recognised by the imaging software. This does not usually cost very much (around £25), and will certainly reduce the amount of ink and paper wasted.

Resolution

The resolution of ink jet and other printers is quoted in dpi (dots per inch) – how many dots can the printer print. Typical figures are 720, 1440 and 2880dpi. These printers are only capable of printing either black ink only, or a combination of coloured inks, cyan, yellow, magenta and black (plus light cyan and light magenta in some cases). Other colours or shades must be created using groups of dots to represent a single shade or colour. This means that a single pixel of information in the original image is represented by a group of dots on the page. This process means that the “effective resolution” of the printed image is lower than the value quoted for graphic or text output. Theoretically, for colour printing on an ink jet printer for example, each pixel in the image needs to be represented by at least four dots of ink, so the effective resolution of a 720 dpi printer is $720/4 = 180$ pixels per inch. Due to the way in which the dots are laid out on the print, and following extensive experimentation, most users find that printers have an “optimum” resolution, though this will vary according to the paper used. In the example above, a 720dpi 6 colour printer might have an optimum resolution of around 220ppi. Use settings for the “finest” or “best” quality in the printer dialog box. These will vary from one make to another.



Screen dump from typical ink jet printer showing paper selection, amount of ink remaining and various utilities



Advanced screen dump from typical ink jet printer showing paper selection and print resolution

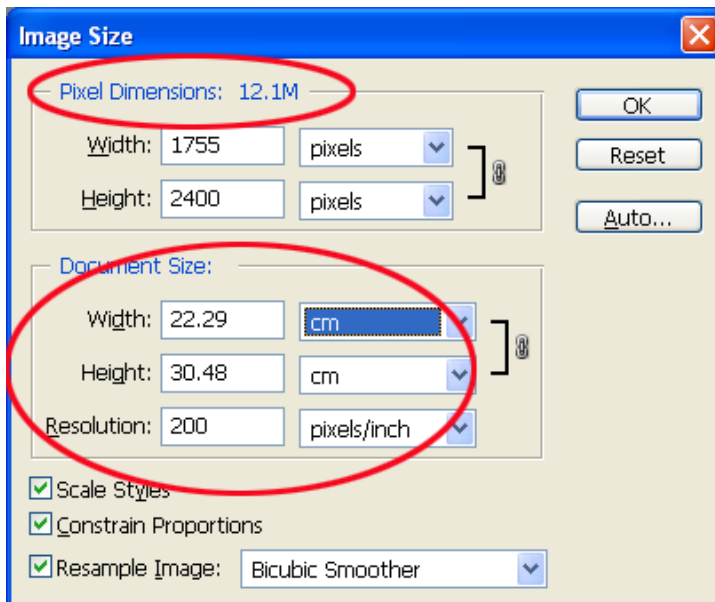


Image size box from Adobe Photoshop, showing image size (12.1 Mb) and print size when printed at 200 pixels per inch

Most imaging programs allow you to re-size your images for a specific resolution of printer. In the example above, a 12.1Mb image will print at a size of 30 x 22cm at a resolution of 200 pixels per inch. If the resolution were lowered, the print size would increase.

Adrian Davies/PIC 2006