

OKI C7000 Series



Colour Guide

Preface

Every effort has been made to ensure that the information in this document is complete, accurate, and up-to-date. Oki assumes no responsibility for the results of errors beyond its control. Oki also cannot guarantee that changes in software and equipment made by other manufacturers and referred to in this guide will not affect the applicability of the information in it. Mention of software products manufactured by other companies does not necessarily constitute endorsement by Oki.

Copyright 2000 by Oki. All rights reserved.

Oki is a registered trademark of Oki Electric Industry Company Ltd.

Energy Star is a trademark of the United States Environmental Protection Agency.

Microsoft, MS-DOS and Windows are registered trademarks of Microsoft Corporation.

EEC compatibility



This product complies with the requirements of the Council Directives 89/336/EEC (EMC) and 73/23/EEC (LVD), as amended where applicable, on the approximation of the laws of the member states relating to Electromagnetic Compatibility and Low Voltage.

Energy Star



As an Energy Star Partner, Oki has determined that this product meets the Energy Star guidelines for energy efficiency.

Table of contents

Preface	ii	OKI C7000 Printer Drivers	19
EEC compatibility	ii	Colour management	20
Energy Star	ii	Windows and Macintosh PostScript driver	21
Table of contents	iii	Windows colour matching	21
Colour Printing	1	Image colour matching	21
Introduction	1	Black finish	21
Use of colour	2	Colour halftone	22
Colour perception	4	Image colour rendering style	22
Electromagnetic spectrum	5	Macintosh colour matching	22
Primary and secondary colours	6	Colour/greyscale	22
Additive and subtractive primaries	7	Black and white	22
Additive primaries	7	ColorSync colour matching	23
Subtractive primaries	8	PostScript colour matching	23
Neutral colours	9	Windows ICM	23
Colour complements	10	No colour matching	24
Colour wheel	11	Print in greyscale	24
Problems using colour	12	Print colour separations	24
Colour management systems	13	Windows PCL driver	25
Specifying colour	14	Auto colour	25
Printing colour	16	Manual colour	25
Colour registration	17	Halftone type	25
Colour adjustments	18	Colour setting	26
		Manual adjustment	26
		Print colour swatch	26

Monochrome	26
Quality	27
Black finishing in photo printing	27
Monochrome dithering	27
Glossary	29
Index	33

Colour Printing

Introduction

This Colour Guide has been conceived to provide you with a broad overview of issues related to colour printing, in order that the best use of colour be made in the software applications used. The text is designed to describe the technical issues in a manner that can be understood by anyone involved in the preparation of colour documents.

Please familiarise yourself with the user documentation provided, which describes operational details of the OKI printer setup and configuration for specific options.

OKI are sure that you will find this colour printer an excellent part of printing solution. If you have any comments with regard to the content of this document, then please let us know through your local OKI representative.

Use of colour

Recent advances have brought colour to the desktop in a way that could not have been imagined a decade ago. It has been shown that using colour in print can increase memory retention by up to 65% and readership by as much as 40%, not to mention the added impact that it provides. As colour becomes more and more accessible it is essential to understand the importance of colour and how best to use it.

People use colour for different reasons; it has become a very important tool and is used widely in marketing to grab attention and communicate ideas and, when used effectively, can alter the viewer's perception.

Colour can be used in text documents as well as for graphics. It can be used to emphasise headings or particular words which would otherwise be lost in the vast array of black and white. Colour adds impetus to a company logo and can be as important as the design itself. The use of colour also makes a document easier to comprehend and can convey information at a glance. For example, using red to highlight negative figures in a spreadsheet.

The use of colour should be considered an integral part of any presentation or document and not added at the end as an afterthought.



The following examples list some widely used colours and their significance:

RED

This is a very powerful and passionate colour. The power and passion it portrays has made it a favourite for many exotic sports cars.

GREEN

Unlike red, green is a very calming and ‘natural’ colour. It signifies trees, grass and plant life in general. It is soothing and perhaps associated with a stroll in a field. As well as the calming side of green, it is also the colour of envy.

BLUE

A cool and refreshing colour. It is the colour of summer skies and a clear blue sea which produces a calming effect. Dark blues are associated with wealth and dignity and also have names that suggest these virtues – Royal blue, Navy blue, etc.

BLACK

This is really an absence of colour and the contrast that it provides with other colours has made it one of the most widely used. Black is usually associated with night and darkness

WHITE

The colour of pure snow and in itself suggests purity. It is used in hospitals to portray an air of cleanliness and sterility. Like black, white can be paired with most colours and is therefore very popular.

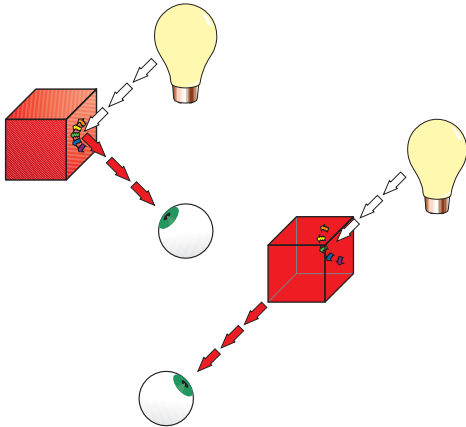
In short, colours can be used effectively to send their own message, regardless of the message that they are supporting. The colours used within a message are seen and automatically decoded before the message itself has been read. This underlines the **importance** and **effectiveness** of using colour.

Colour perception

Colour does not exist by itself but is dependent on the presence of:

- a light source
- an object
- an observer

Our perception of colour involves light from a source being reflected off, or transmitted through, an object and entering the eye.



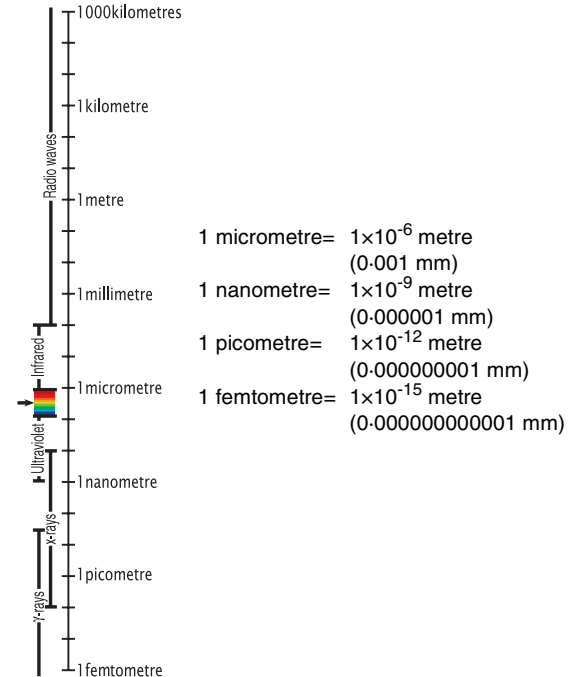
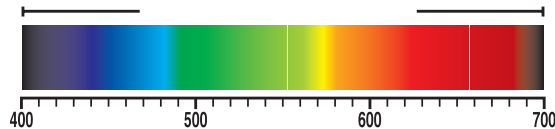
Light interacts with an object and what we see is the final result of that interaction. An object can reflect, transmit or emit light. A reflective object absorbs some sections of the visible spectrum and reflects the rest. What we see is the reflected portion. An object removing wavelengths at the ultra violet end for example, will appear red in hue. A transmissive object allows light to pass through it and may absorb a section. The colour of the object in this case will depend upon the wavelengths of light that are allowed to pass through. An emissive object emits light and the appearance of the light will depend on the wavelengths emitted. In short, the composition of the light and its interaction with the object will define the colour we see.

Electromagnetic spectrum

All colours we can see fall into what is the visible part of the electromagnetic (EM) spectrum. The visible portion of the EM spectrum is minute and although we are 'blind' to the rest, the part we can see has a significant effect on our perception of everything around us.

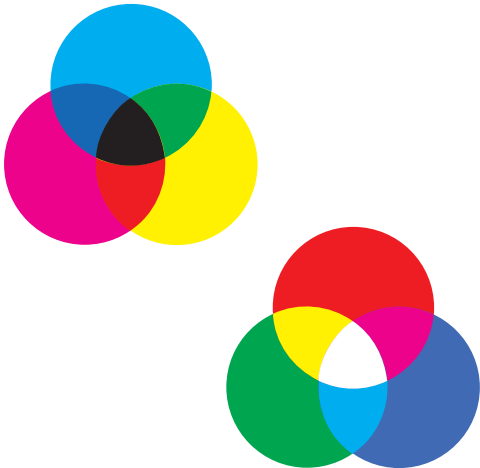
If light containing all visible wavelengths in balanced quantities is detected, then white light is seen. If there is an absence of all wavelengths then black is perceived. The infinite combination of different wavelengths give rise to what we perceive as colour. So colour is light.

When our eyes receive information containing a strong content of a particular wavelength then we interpret that as a colour. A strong content around 700 nm (0.0007 mm wavelength) is interpreted as red and at the other end of the scale, 400 nm is interpreted as violet.



Primary and secondary colours

In theory, all colours can be made up from a very small group of 'colour elements'. There are three primary colours, and all other colours can, in theory, be obtained by mixing the primary colours in varying proportions. Mixing two primary colours in equal proportions produces what is known as a secondary colour.



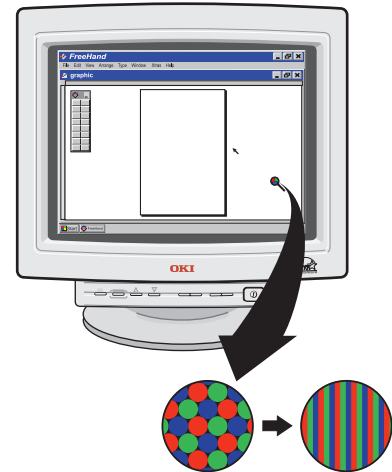
Additive and subtractive primaries

Primary colours can be split into two categories which are termed additive and subtractive. It is important to note the difference between mixing additive primaries and subtractive primaries. For example mixing red and green inks will produce a 'muddy' brown, whilst red and green light mixes to give yellow. So in which way do the two models differ ?



Additive primaries

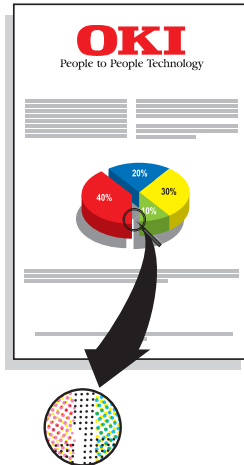
Video technology such as computer monitors and television screens use the additive model. The additive primaries are Red, Green and Blue (RGB). Starting from black (lack of colour) and adding red, green and blue in equal quantities will generate shades of grey with white being generated with full, balanced intensities of all three. Mixing the three colours in different quantities will generate intermediate colours.



Subtractive primaries

Cyan, Magenta and Yellow (CMY) are known as the subtractive primaries and are commonly used in printing processes. In this case we start with a white background (usually paper) and add translucent inks of cyan, magenta and yellow to subtract certain wavelengths of light. For example, cyan ink on a page appears to be this colour because the ink removes components of red light and reflects green and blue, which we perceive as cyan.

In theory, a combination of the three subtractive primaries will produce black. In practice however, pigments used in inks are not perfect and usually give rise to a dark green/brown. For this reason, in many colour output devices, a separate black ink is used to produce greys and black (in shadows and black text for example). This is the CMYK model and is the method most widely used in the colour printing and printer industry. The OKI C7200 and OKI C7400 printers use separate cartridges of cyan, magenta, yellow and black toner to generate high definition colour images for the workgroup or networked environment.



Neutral colours

Although the term 'colour' is applied, neutral colours do not have properties of hue or saturation. They are described in terms of lightness only. The neutral colours are black and white and all shades of grey in between. A balanced mix of cyan, magenta and yellow yields a neutral colour or black (in theory). The same effect can be achieved with the additive primaries by having an equal mix of red, green and blue light.

Colour complements

Complements are pairs of colours that combine to produce a neutral colour. It can be seen from the above that balanced quantities of all three primaries produce a neutral. Mixing two primaries produces a secondary colour. Mixing this secondary colour with the remaining primary colour produces a neutral colour. For example:

CYAN + MAGENTA + YELLOW = NEUTRAL

- red (magenta + yellow)+ cyan= NEUTRAL
- green (yellow + cyan)+ magenta= NEUTRAL
- blue (cyan + magenta)+ yellow= NEUTRAL

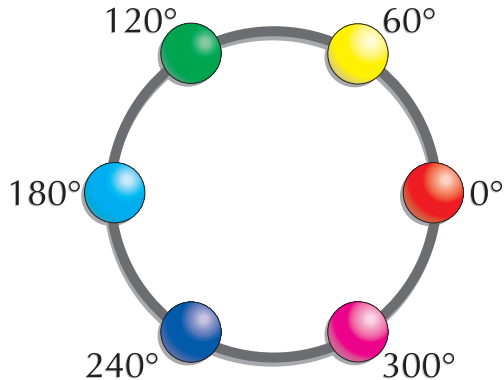
This relationship can be applied to all colours and is shown in more detail in the following section.

Colour wheel

The relationship between colours can be best shown on what is known as a colour wheel. The hue value of a particular colour is expressed in degrees. Red for example is at 0° and green and blue are located at 120° and 240° respectively. The subtractive primaries, yellow, cyan and magenta are located at mid points between these.

The colour wheel shows the following relationships:

- the additive primaries are displaced by 120° from each other.
- the subtractive primaries are displaced by 120° from each other.



- each colour is a secondary colour of the two colours either side of it. For example, mixing equal quantities of yellow and magenta will produce red.
- a colour is directly opposite its complement.

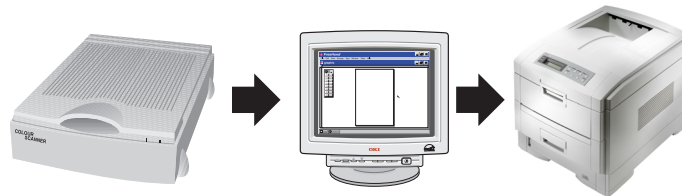
We can continue to mix neighbouring colours on the colour wheel to produce further, intermediate colours. The number of colours on the colour wheel now doubles to twelve (as shown below). Repeating the procedure a number of times produces a colour wheel with subtle changes of hue from neighbour to neighbour.



Problems using colour

As already explained, a computer monitor, where an image is first viewed, and a printer, which produces the final document, use different methods to generate colours. Indeed they are based around a different set of primaries (RGB for monitors, CMYK for printers). Monitors do not generate a full range of perfect colours and neither do printers. There is a limit on how many colours a monitor or printer can generate. This is known as a device's colour gamut. Some colours can be reproduced by both devices, while others can be displayed on a monitor but cannot be printed or vice versa. This in practice may lead to a colour print not resembling the original on-screen image. So what has happened?

Images (graphics and text) can be captured through scans or digital photography, or input directly into the PC via applications programs. However the original image is obtained, it will be displayed and manipulated in RGB colour space (on-screen) and finally converted to CMYK for print. Each of these processes requires data conversion/manipulation. An image seen on a computer monitor relies on the monitor's ability to reproduce the image and represent colours within it. Adjustments such as brightness, colour and contrast also tailor the image to the preference of the viewer rather than a display of true colour. The data sent to the printer may not be adjusted to allow for imperfections in the inks used.



Colour management systems

Colour management systems (CMS), such as those found in the OKI C7200 and C7400 printer drivers, allow for any mismatches that may occur between the RGB and CMYK conversion process. Colour matching systems go a long way to ensuring a better match between the input data and printed result, but cannot always allow for monitor adjustment or a variation in paper stock. Paper can sometimes appear blue or cream in hue which will have an effect on the light reflected from the page and therefore change the appearance of some colours. The texture of the paper used will affect the way that light is scattered and may also result in patches of light or dense colour. It is therefore best to find and adopt a paper that provides you with the best results. This of course may be a process of trial and error.

Although colour has its obvious benefits, it has also created a whole new set of problems that need to be dealt with:

- It is important not to go overboard and add dashes of colour without thought as this will undoubtedly have a negative effect on the whole purpose of using colour.
- Using colours which are considered garish will also affect the way in which your document or presentation is perceived.
- The proximity of colours is also an important factor and it is best to consider the result when certain colours are paired.

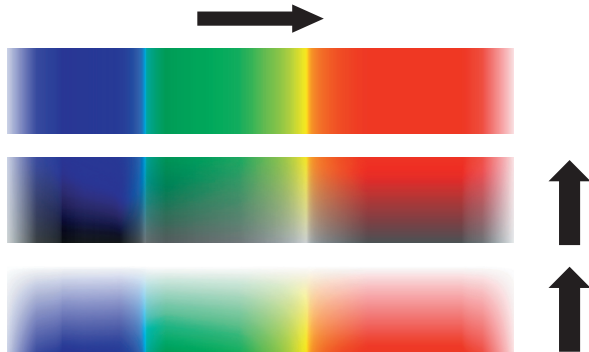
To minimize any problems it is important to use colour with pre-planning and a great deal of care. If specific colours are of paramount importance (such as those in a company logo) then it is best to print these colours beforehand and note the composition that gives the closest match to the required colour. Then use the component amounts regardless of what is displayed on the monitor.

Specifying colour

There are many different ways to specify colour and there are many different models to cater for this. The colour wheel, as already shown, is a two-dimensional view of the HSL model which is based on Hue, Saturation and Lightness as components for specifying colour. The third dimension in this case is lightness and describes the tendency towards black or white.

Commonly used models are:

- HSL
- HSB
- CMY(K)



- RGB
- CIE, CIELab, CIELuv
- YCC

Each of the models have their benefits and disadvantages and are useful in particular situations. Most applications will have support for the RGB model which (along with CMYK) is perhaps the simplest to use. This model is used to specify colours by varying the proportions and levels of the red, green and blue components.

The amount of red, green and blue present in a colour is usually expressed as a number from 0 to 255. Less commonly it may also be expressed as number between 0 and 65535 or as a percentage. Converting between the systems is straight forward and a few examples are given below:

Example:

To achieve a colour that is described as 100% red, 50% Green and 40% blue...

255 Colour scale:

$$\begin{aligned} 100/100 \times 255 &= 255 \text{ red} \\ 50/100 \times 255 &= 128 \text{ green} \\ 40/100 \times 255 &= 102 \text{ blue} \end{aligned}$$

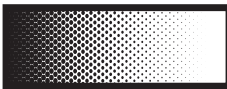
65535 Colour scale:

100/100×	65535 =	65535 red
50/100×	65535 =	32768 green
40/100×	65535 =	26214 blue

The printout from this set of numbers should produce a colour close to the original. Due to the variation in printer inks however, it may be necessary to make minor adjustments until the right combination is found. Once a colour match is obtained, the RGB components should be entered regardless of the colours displayed on-screen. To maintain colour consistency it is recommended that OKI original consumables are used as they are specifically manufactured for the OKI C7200 and C7400 printers.

Printing colour

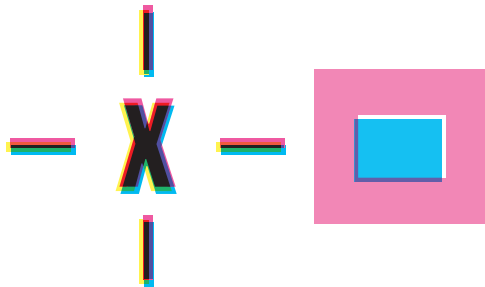
No matter how colours are specified, the printer is only able to use a combination of three colours plus black to generate an image on paper. To achieve this the printer uses processes known as halftoning and dithering. Each addressable picture element (pixel) on a monitor screen or printed output contributes to what we see in the final image. The pixels are placed in close proximity so the eye is unable to resolve individual dots. Colours of adjacent pixels appear to merge and produce a new colour. Using dot patterns of a given set of colours to generate new colours is known as dithering. Shades of grey can be generated by using a similar technique of black dot placement. This technique is known as halftoning and gives rise to what we perceive as a continuous tone image. Examples of dither and halftone are shown below:



The entire printing area is split into sections known as cells (much like a grid). The patterns within the cell are then altered to obtain the required amount of greyscale. An area of an image containing 50% grey will contain cells that have half of the dots within the cell printed with black and the other half left empty.

Colour registration

The CMYK printing process, as already stated, uses overlapping inks of cyan, magenta and yellow. To produce the best possible output, the colours must print in specific positions so that overlaps and dithering are accurate. If the colours are not aligned, the resulting print will have colour shifts (colours produced where incorrect colours overlap to produce an undesired colour) or appear blurred. Using black to print grey and also black in text eliminates the problem in these instances but not when colour is constructed from two or more of the process primaries. The illustration shows how registration problems can cause undesired effects.



Colour adjustments

Certain images such as bitmaps, sometimes print with a strong hint of a particular colour. Images that appear fine when viewed on a monitor may not necessarily print that way due to the reasons described previously. The colour that appears to dominate the picture will vary depending on factors such as the scanner (or other input device) having a bias towards a particular colour, or the monitor's ability to represent certain colours on-screen. To compensate for this, OKI C7200 and C7400 printers have a colour adjustment system that can reduce the amount of any of the process colours put on the page in relation to the others. The printer drivers supplied with your printer provide these adjustments, which are outlined in this manual and explained in more detail in the driver's on-line help. (Click on the Help button in any driver dialog box.).

This is useful if, for example, you find that all of your graphics have a tendency to contain too much blue. To compensate for this, you could reduce the amount of cyan or magenta as it is these two colours that combine to produce blue. Bear in mind that other colours containing cyan or magenta will also be affected. An alternative would be to increase the amount of yellow. This has the advantage of increasing colour saturation while balancing the image.

Another method of decreasing strong colours is to increase the lightness setting in the printer driver. To compensate for this, the saturation setting must be stepped down accordingly. As a rule, the saturation should be stepped down an equal number of steps to the level that the lightness has been stepped up.

OKI C7000 Printer Drivers

There are various features designed to allow you to achieve the best results with your OKI C7000 Series of printers. The colour options within the printer driver provides a list of colour matching techniques and adjustments which can be applied to your graphics and text to provide the optimum balance of colour on your document. The options and adjustments that can be made are described below for each of the different printer drivers. Clicking on the properties button after a print request has been made allows you to carry out colour adjustments before printing the document.

Colour management

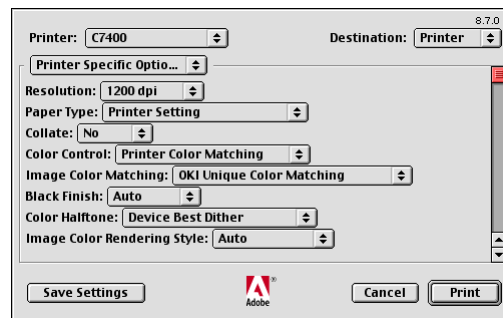
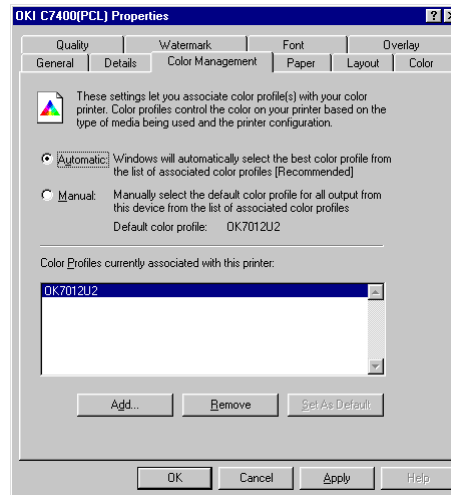
Colour management ensures the best rendition of colours when an image or page is displayed on your monitor and printed by your printer. In most cases, colour management works automatically using colour profiles that are installed when a printer or monitor is installed. These colour profiles are used every time colours are displayed or printed.

Users with specialised needs, such as graphic artists and desktop publishers, can manually specify which colour profile a printer or monitor uses, or which colour profile is used for images or pages with special colour reproduction requirements.

There are two settings for colour management and these are as follows:

Automatic - Windows automatically selects the best colour profile to use from the list of associated colour profiles stored on your computer. This is the recommended setting for colour management.

Manual - This allows you to manually select which colour profile to use from the list of associated colour profiles for all output from the printer if you have specialised needs for colour printing.



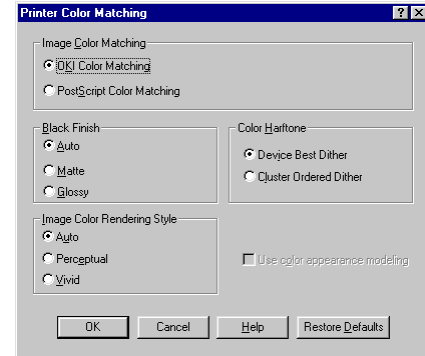
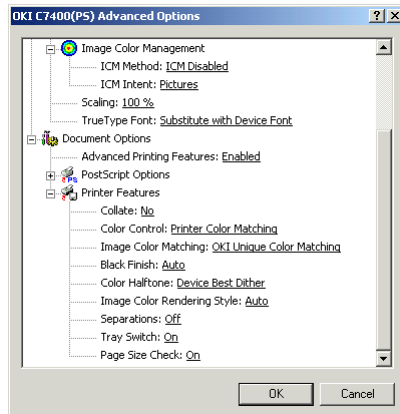
Windows and Macintosh PostScript driver

Windows colour matching

Clicking on the Options button allows you to select the settings for colour matching system built into the printer.

Image colour matching

OKI Colour Matching - This option carries out a colour matching process using ASIC installed in a printer. The colour matching process is applied when



print data with RGB colour space used in general applications is converted into CMYK colour space of a printer.

PostScript Colour Matching - This option carries out a colour matching process using the colour rendering dictionary of Adobe PostScript.

Black finish

Auto - This option generates black in the most appropriate method for the document to be printed. This is the default setting and is recommended for most print jobs.

Matte - This option generates black only with black toner and is the best setting for graphics and texts. If the

dark part of a photograph is printed with a blackish tone, then please use Auto or Glossy setting.

Glossy - With this setting black is composed of cyan, magenta, yellow and black toner giving a brownish and glossy black, which is best for printing photographs.

Colour halftone

Device Best Dither - This setting carries out dithering that focuses on expression (resolution) and is best used for printing graphics and text.

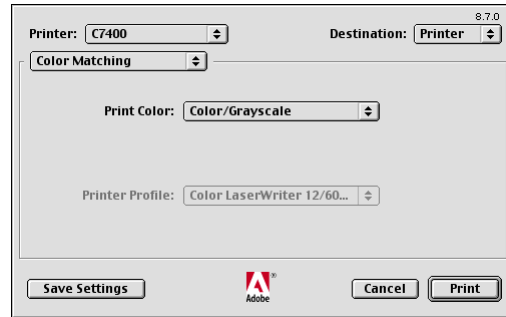
Cluster Ordered Dither - This setting carries out dithering to give smooth gradation between colours and is best used for printing photographs.

Image colour rendering style

Auto - This setting matches colours using the most appropriate method for the document being printed. This is the default setting and is recommended for most print jobs.

Perceptual - This setting gives colours with more contrast. All colours are equally converted into colours within the colour range of the printer.

Vivid - This setting gives colours with more brightness. Colours outside the colour range of the printer are converted into colours with close saturation in the colour range.



Macintosh colour matching

Colour/greyscale

The Colour/Greyscale setting enables the Adobe PostScript to send colour data to colour printers or equivalent greyscale data to monochrome printers. The Colour/Greyscale setting produces better black-and-white output than the Black and White option, even on monochrome printers and is the default setting.

Black and white

The Black and White setting limits printing to monochrome only. Use this option if you want your printed output identical to the output you can obtain using the Apple LaserWriter 7.x printer driver with black-and-white printers.

ColorSync colour matching

The ColorSync Color Matching setting enables a Macintosh computer to convert from one colour representation to another (for example, from monitor colour to printer colour) using colour rendering dictionaries that reside on the Macintosh computer.

This setting requires a printer profile, which contains information defining the colours that the printer can represent. This setting is available only if the Apple ColorSync software is installed.

Choose this setting if your Macintosh processor is faster and more powerful than your printer because it will improve overall color-printing performance.

PostScript colour matching

The PostScript Color Matching setting enables your printer to convert from one colour representation to another (for example, from monitor color to printer color) using colour rendering dictionaries that either reside on the printer or have been downloaded from the computer to your printer. Use this option if your printer is not colour calibrated and uses PostScript Level 3.

This setting requires you to select a printer profile, which contains information defining the colours that the printer can represent.

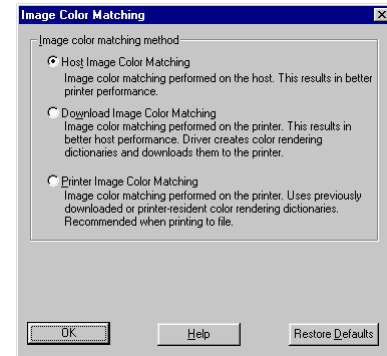
Windows ICM

Clicking on the Options button allows you to select the settings for Windows image colour matching.

Host Image Colour Matching - All image colour matching is carried out by the computer and gives a better printer performance. This is the default setting.

Download Image Colour Matching - Image colour matching is carried out by the printer which results in better computer performance. The printer driver creates colour rendering dictionaries and downloads them to the printer before printing.

Printer Image Colour Matching - Image colour matching is carried out by the printer using colour



rendering dictionaries that have been previously downloaded to the printer or are resident in the printer. This setting is recommended when printing to file.

No colour matching

This setting does not carry out colour matching. Choose this setting when you use the colour matching system of the software application being used.

Print in greyscale

Prints in greyscale using the colour information to produce the various shades of grey that are required.

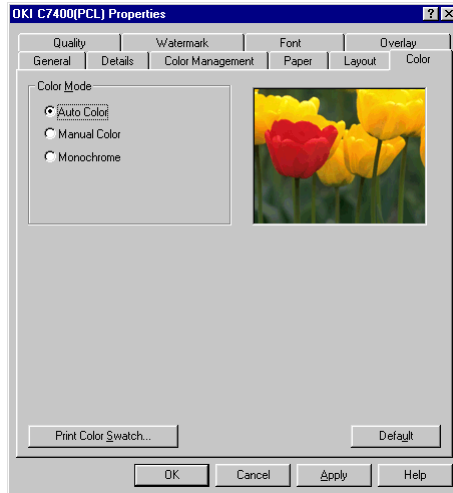
Print colour separations

This setting can be used if a software application does not support printing colour separations of cyan, magenta, yellow and black.

Windows PCL driver

Auto colour

Using Auto Colour, the printer automatically adjusts to the colours specified in the document and prints. This is the optimal printing mode for colour and is the default setting. For normal printing, it is recommend to use this setting.



Manual colour

With Manual Colour, you can adjust each item of the colour setting. This setting is recommended for users who have lot of experience using colour. When using manual colour settings, the printed colours can differ greatly from the colours on the monitor screen.

Halftone type

Error Diffusion - A method of colour reduction that spreads out any inaccuracies when representing a pixel of colour with the surrounding pixels.

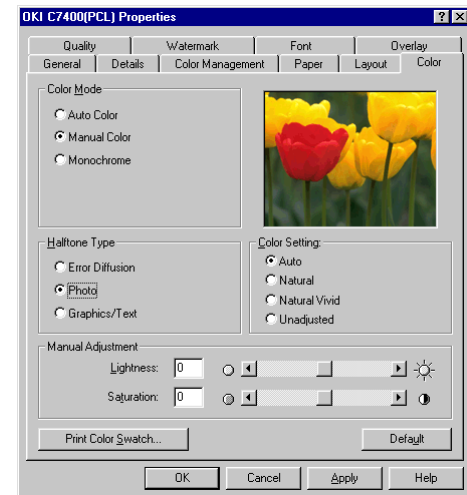


Photo - This setting carries out dithering to achieve smooth tone that is required when printing photos.

Graphics/Text - This setting carries out dithering with an emphasis on form expression (resolution) that is required when printing graphics and texts.

Colour setting

Auto - Prints each photo, graphic and character in the most suitable colours.

Natural - Makes the colours close to those seen on the screen. Sometimes the printed colours do not match those on the screen because colour characteristics (brightness, saturation and contrast) of the monitor cannot be recognized.

Natural Vivid - Colours are printed as brightly and vividly as possible, i.e. colours are more saturated and vibrant.

Unadjusted - No colour adjustment is carried out and data is sent directly to the printer. Printed colours may not match those specified within the document.

Manual adjustment

Lightness - This allows the image brightness to be adjusted so that colours within it tend to appear closer to black (negative adjustment or darker) or white (positive adjustment or lighter).

Saturation - This adjusts all colours within the image so that they appear dull (negative adjustment) or vivid (positive adjustment).

Print colour swatch

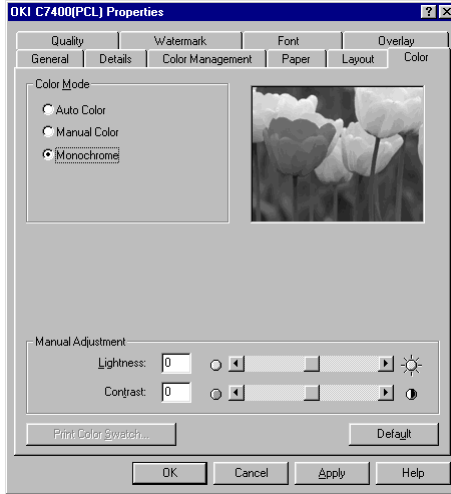
Pressing this button allows the choice of printing out 4 pages or 12 pages of colour swatches from the printer. These colour swatches are a range of colours and their corresponding RGB (Red Green Blue) values. This makes it possible to select a specific colour and see how it will print from any application which allows you to define colour using RGB values.

Monochrome

All print data is sent as monochrome (black and white) with colours being output as greyscale. Only the black toner cartridge is used in this instance. The only manual adjustments that can be made are as follows:

Lightness - This allows the image brightness to be adjusted so that greyscales within it tend to appear closer to black (negative adjustment or darker) or white (positive adjustment or lighter).

Contrast - This adjusts the vividness of the greyscales within the image so that they appear dull (negative adjustment) or vivid (positive adjustment).

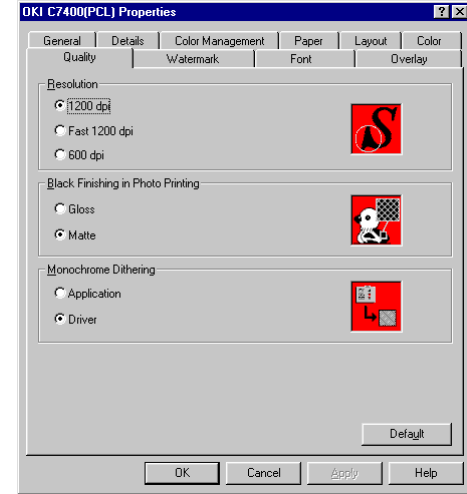


Quality

Two further options are available for colour printing after clicking on the Quality tab in printer properties.

Black finishing in photo printing

True black - This option generates black only with black toner (K) and is the best setting for graphics and text. If the dark part of a photograph is printed with a blackish tone, then please use composite black setting.



Composite black (CMYK) - With this setting black is composed of cyan, magenta, yellow and black toner giving a brownish and glossy black. This setting is best for printing the darker parts of photographs with a slightly lighter tone.

Monochrome dithering

This option gives the choice of allowing the printer driver or the software application to carry out dithering when printing in monochrome.

Glossary

Brightness - Brightness is the relative lightness or darkness of a colour and is usually measured as a percentage from 0% (black) to 100% (white).

Cluster-dot screening - This is a halftoning method that uses multiple pixels that vary from small to larger dots as the colour gets darker. It is characterized by a polka-dot look.

Colour gamut - The range of colours that a device can produce is known as its colour gamut. Devices are unable to produce all colours that occur in nature so their colour gamut is a subset of this.

Colour management system (CMS) - A system used to communicate colour fidelity across devices such as input, display and output to ensure that the best colour rendition possible is given at all times.

Colour mapping - This is the translation of colour representation from one device (or system) to another.

Colour models - A colour model is a system that allows colours to be arranged or identified. There are various models in existence, with some more suitable to specific applications than others.

- **RGB** - Computer monitors for example, use red, green and blue phosphors to display images and colours are specified using the RGB model.
- **CMY(K)** - Cyan, magenta, yellow and black are the inks used in the four colour print process and there is a model used to describe this. Due to the imperfections in printing inks, black is added rather than produced by mixing the other three inks. Black is identified as 'K' to avoid confusion with other colours such as blue.
- **HSL** - Colours are defined by hue, saturation and lightness.
- **HSB** - Colours are defined by hue, saturation and brightness. The dimensions are similar to the HSL model but the HSB model is related to the RGB system.
- **YCC** - This system was developed by Kodak for encoding colour images for display on video monitors. RGB values are converted to a luminance component (Y) and chromatic components (C1) and (C2).

- **CIE** - In 1931 the Commission Internationale de l'Eclairage (CIE) devised a colour system based on the human visual system and is an accepted standard. This system is not linear and difficult to interpret. There have been modifications to the system that have given rise to CIELab and CIELuv.

Colour separations - Each of the process colours are printed separately and must therefore be specified individually, as the colour is needed. Image data is therefore split into the primary colours (plus spot colours) before printing.

Colour space - This is a method of describing colour. Some systems are device-dependent such as RGB and CMYK. The CIE system is a device independent colour space. Note that all colour models are not colour spaces in their own right.

Colourants - These are the colours used by a device to reproduce colour. A printing press uses the CMYK colourants.

Density - In this context, there is no relation to the mass and volume of the object, but is the ability of the object to absorb light. The more light absorbed, the higher the object density.

Dithering - A technique where pixels of different colours are placed in close proximity to give the illusion of another colour as perceived by the human visual system.

Dot gain - During the printing process, inks may spread causing dots on a page to print larger than intended. This results in darker tones and colours. The problem can be compensated for by careful adjustment.

Error diffusion - This is usually associated with halftoning but can also be used with dither. The error between a pixel and its intended value is propagated to adjacent pixels to produce a balanced overall effect. Results may sometimes appear grainy.

Greyscale - Differing shades of grey ranging from black to white. Eight bits of data will produce 256 shades of grey.

Halftoning - A printed image is composed of dots (or pixels). The spacing of these pixels can give the illusion of shades or tone. Increasing the spacing of dots lightens the shade so that it tends towards white (colour of the page).

Highlight - This is the lightest part of an image. In the extreme, this would be white.

Hue - Hue is the colour reflected from or transmitted through an object. It is measured as a location on the

standard colour wheel, expressed as a degree between 0° to 360°. In common use, hue is identified by the name of the colour such as red, green, orange, etc.

Indexed colour - Colour pixels are represented by 8-bits. This gives the possibility of 256 colours which are contained in a lookup table.

Lightness - This describes the intensity of a colour and determines whether a colour is closer to black or white.

Moiré pattern - This is an undesirable pattern that occurs due to pixel (or) dot placement. The eye is able to pick up repetitive patterns that exist within an image. These can be eliminated during print by careful selection of screen angles.

Pixel - This is the smallest addressable dot or PICTURE ELEMENT. This has been abbreviated as PIXEL rather than PICELE.

Primary colour - All colours can be produced by mixing a limited set of colours. There are two different sets of primary colours associated with the video and printing industries:

- **Additive primaries** - Red, Green and Blue (RGB) are the additive primaries and the basis for forming other colours in displays such as computer monitors or television.

- **Subtractive primaries** - Cyan, Magenta and Yellow (CMY) are the subtractive primaries and are the basis for inks used in colour printing. Colour is produced because inks are designed to absorb certain wavelengths of light and transmit others.

Registration - This describes the alignment of the various colours when printing. As each of the process primaries are specified by their own plate and printed individually, it is important that the ink is placed in precise locations or colours will not align to produce the desired result.

Saturation - Saturation, sometimes called chroma, is the strength or purity of the colour. It represents the amount of grey in proportion to the hue and is measured as a percentage from 0% (grey) to 100% (fully saturated). On the standard colour wheel, saturation increases from the centre to the edge.

Secondary colour - Mixing two primary colours in equal amounts will produce a secondary colour.

Spot colour - These are additional colours used in printing that are not a part of the process ink set and specified individually. These colours are required when the end result is of paramount importance (such as within a corporate logo) as there is a substantial increase in cost. A separate plate is also required.

Index

A

Additive primaries	7, 31
Adjustments of colours	18
Auto colour	25

B

Black and white	22
Black finish	21
Brightness	29

C

CIE	14, 30
Cluster dot screening	29
CMY(K)	14, 29
ColorSync	23
Colour gamut	29
Colour management	20
Colour management systems	13, 29
Colour mapping	29
Colour matching	
ColorSync	23
Macintosh	22

PostScript	23
Windows	21
Colour models	29
Colour separations	24, 30
Colour setting	26
Colour space	30
Colour swatch	26
Colour wheels	11
Colourants	30
Colours	
Adjustments	18
Complements	10
Models	14
Neutral	9
Perception	4
Primary and secondary	6
Printing	16
Problems using	12
Registration	17
Significance and effectiveness	3
Specifying	14
Using	2

Composite black	27
Contrast	26

D

Density	30
Dithering	30
Dot gain	30

E

Electromagnetic spectrum	5
Error diffusion	25, 30

G

Greyscale	22, 30
---------------------	--------

H

Halftone	22
Halftoning	30
Highlight	30
HSB	14, 29
HSL	14, 29
Hue	30

I

Image colour matching	21
Image rendering styles	22
Indexed colour	31

L

Lightness	26, 31
---------------------	--------

M

Macintosh colour matching	22
Manual adjustments	26
Manual colour	25
Models of colour	14
Moiré pattern	31
Monochrome	26

N

Neutral colours	9
---------------------------	---

P

Perception of colour	4
Pixel	31
Primary colours	6, 31
Additive	7
Subtractive	8
Printer drivers	19
Colour management	20
Colour matching	22
Colour separations	24
Greyscale	24
Macintosh	22
No colour matching	24

Windows colour matching . . . . .	.21
Windows PCL . . . . .	.25
Windows PostScript . . . . .	.21
Printing colour . . . . .	.16
Problems . . . . .	.12

R

Registration . . . . .	.31
Registration of colours . . . . .	.17
RGB	14, 29

S

Saturation . . . . .	.31
Secondary colours	6, 31
Specifying colours . . . . .	.14
Spot colour . . . . .	.31
Subtractive primaries	8, 31

T

True black27
----------------------	-----

W

Windows colour matching . . . . .	.21
Windows image color matching . . . . .	.23

Y

YCC	14, 29
---------------	--------

OKI SYSTEMS COMPANIES

Oki Systems (UK) Ltd
550 Dundee Road, Slough Trading Estate
Slough, Berkshire SL1 4LE
UNITED KINGDOM

Tel: +44 (0) 1753 819 819
Fax: +44 (0) 1753 819 899

<http://www.oki.co.uk>

Oki Systems (Ireland) Limited
The Square Industrial Complex
Tallaght, Dublin 24
EIRE

Tel: +353 (01) 459 8666
Fax: +353 (01) 459 8840

<http://www.oki.ie>

Hawthorn Business Centre
Adelaide Industrial Estate
Falcon Road, Belfast BT12 6HP
NORTHERN IRELAND

Tel: +44 (028) 9057 2355
Fax: +44 (028) 9057 2350

<http://www.oki.ie>

Oki Data Corporation
4-11-22, Shibaura, Minato-ku, Tokyo 108-8551
JAPAN

Tel: +81 (0) 3 5445 6111
Fax: +81 (0) 3 5445 6182

Oki Electronics (Hong Kong) Ltd
Suite 1901-9, Tower 3, China Hong Kong City
33 Canton Road, Tsim Sha Tsui, Kowloon
HONG KONG

Tel: +852 2736 2336
Fax: +852 2736 2395

Oki Electronics (Singapore) Pte Ltd
78 Shenton Way, #09-01
SINGAPORE 079120

Tel: +65 221 3722
Fax: +65 221 9282

Oki Systems (Thailand) Ltd
956 UdomVidhya Building 6th Floor, Rama IV Road
Silom, Bangrak, Bangkok 10500
THAILAND

Tel: +662 636 2535
Fax: +662 636 2536