D Modifying Output Color (Color LaserJet, 5, 5M, DeskJet)

Introduction

The previous appendices of this manual have been concerned with giving an overview of the color printing process, choosing color modes, and using palettes. This portion of the manual explains how color can be modified to produce a desired result, from using halftone render algorithms to change the way color is rendered, to compensating for the yellow cast caused by a tungsten light source in a photograph. The HP color printers can modify colors using the following means:

- *Halftone render algorithms* provide a way to modify images based on a dither cell concept. The algorithm chosen determines how specified colors are "rendered" as dots on the printed page.

- *Color lookup tables* can remap palette colors to compensate for unwanted color characteristics of input data. For example, if a scanned photograph had a reddish cast, a color lookup table could be used to make the printed image look as if it were taken under a more balanced light source.

- *Gamma correction* provides a way to adjust for color differences in display monitors.

- The *Viewing Illuminant* command allows you to vary the xy chromaticity coordinates for the light source under which you will be viewing a printed piece. For example, if the printed document is to be viewed under a tungsten light, the command modifies colors so that they have the correct appearance when illuminated by a tungsten light bulb.

- The *Monochrome Print Mode* command converts each color to its grayscale equivalent for faster draft printing.

- The *Driver Configuration* command provides a way for a driver to calibrate the output by adjusting color lightness, saturation, and color map information.

All of these methods of modifying output color are explained in the following sections.

Halftone Render Algorithms

The HP color printers have the capability of applying different halftone render algorithms to achieve the desired output on the printed image. Render algorithms allow you to change the characteristics of the image by changing the way pixels are rendered. Each halftone render algorithm produces a different affect on the output, varying the texture and color appearance of the printed image.

To choose the type of rendering to be used, use the Render Algorithm command, described below. This command allows you to choose one of the existing rendering algorithms or to choose a user-defined pattern created with the Download Dither Matrix command.

Render Algorithm Command

The Render Algorithm command selects the algorithm to be used for rendering page marking entities on a given page.

E_C*t#J

# =	0	-	Continuous tone (device best dither)
	1	-	Snap to primaries
	2	-	Snap black to white, color to black
	3	-	Device best dither
	4	-	Error diffusion
	5	-	Monochrome device best dither
	6	-	Monochrome error diffusion
	7	-	Cluster ordered dither
	8	-	Monochrome cluster ordered dither
	9	-	User-defined dither
	10	-	Monochrome user-defined dither
	11	-	Ordered dither
	12	-	Monochrome ordered dither
	13	-	Noise ordered dither
	14	-	Monochrome noise ordered dither
	15	-	Continuous tone smooth 150 lpi

16	-	Monochrome continuous tone detail 300 lpi
17	-	Monochrome continuous tone smooth 150 lpi
18	-	Continuous tone basic 100 lpi
19	-	Monochrome continuous tone basic 100 lpi

Default = 3

Range = 0 to 19 (invalid values are ignored; values 1, 2, 9, and 10 are ignored for device independent color)

Snap to Primaries

This algorithm converts each component of a color specification to its corresponding primary color. For example, assuming 8 bits per primary, an RGB input value greater than 128 snaps to 255; a value less than or equal to 128 snaps to 0.

Snap Black to White, Colors to Black

Choosing this option converts black to white and all other colors to black. Input primary colors equal to a black specification are converted to a white specification, and other color specifications for the input primaries are converted to the black specification.

Device Best Dither

This dither pattern produces the best results for many images. Note, however, that the recommended dither pattern varies with the image, the intended use of the image, and the subjective judgements of the user.

Error Diffusion

The input primaries of a given pixel (x,y) are printed at the closest density available and the local error is propagated to the unprinted neighboring pixels. Error diffusion applies only to raster data printed using the Configure Image Data command.

Ordered Dither and Clustered Ordered Dither

The ordered dither or cluster ordered dither causes a pixel to be intensified at a point (x,y) depending on the desired intensity, I(x,y), and on an n x n dither matrix, D, where:

i = x modulo n

j = y modulo n

For RGB color spaces, if I(x,y) < D(i, j), the point corresponding to (x,y) is intensified; otherwise it is not. The intensity of each primary color is determined according to this scheme. The relationship between I and D depends on the specified color space.

Monochrome Rendering

Monochrome rendering generates a gray value from the three primary colors. The gray value is computed according to the NTSC standard, which for the Device RGB color space is:

Gray = 0.3 x Red 0.59 x Green 0.11 x Blue

User-Defined Dithering

For a user-defined dither, the input primaries are compared against differently dimensioned dithers (e.g. MxN), which may vary for each primary color.

Note   Render algorithms 1, 2, 9 and 10 are not accessible when in a device-independent color space because it is impossible to characterize a printer for all possible dither algorithms. If one of these render algorithms is selected when in a device-independent color space, the device best dither algorithm will be used instead.

HP Color LaserJet 5 and 5M printers do not support user-defined dithering.

Non-Continuous Tone Algorithms

HP Color LaserJet 5 and 5M printers remap non-continuous tone render algorithms into continuous tone algorithms. The following remapping takes place:

Snap to primaries	=	Snap to primaries
Snap black to white, color to black	=	Snap black to white, color to black
Device best dither	=	Continuous tone smooth 150 lpi
Error diffusion	=	Continuous tone smooth 150 lpi
Monochrome device best dither	=	Monochrome continuous tone smooth 150 lpi
Monochrome error diffusion	=	Monochrome continuous tone smooth 150 lpi
Cluster ordered dither	=	Continuous tone smooth 150 lpi
Monochrome cluster ordered dither	=	Monochrome continuous tone smooth 150 lpi
User-defined dither	=	Continuous tone smooth 150 lpi
Monochrome user-defined dither	=	Monochrome continuous tone smooth 150 lpi
Ordered dither	=	Continuous tone smooth 150 lpi
Monochrome ordered dither	=	Monochrome continuous tone smooth 150 lpi
Noise ordered dither	=	Continuous tone smooth 150 lpi
Monochrome noise ordered dither	=	Monochrome continuous tone smooth 150 lpi

User-Defined Dithers

The Download Dither Matrix command (E_C*m#W) can create a dither matrix for one or all three primary colors, in effect providing halftone screens. User-defined dither matrices can be used for optimizing the printer's output capabilities when using device-dependent color spaces. They are ignored for device-independent color spaces, since the printer cannot be calibrated as is necessary for device-independent color. User-defined halftones can be downloaded for each component of the color space.

A user-defined matrix is defined in additive colors (RGB values). The dither matrix pixels are defined in terms of device-dependent resolution.

When using the Download Dither Matrix command, you have several options:

- You can choose whether to define a separate matrix for each color plane, or use the same matrix for all three color planes.
- You set the height and width of the dither cell. When using separate matrices for each plane, you can use different size dither cells for each plane. For example, you can have a 4 x 4 pixel cell for red, a 4 x 6 cell for green, and a 6 x 8 cell for blue.
- You download the data bytes for each pixel of the cell. Each data byte determines a threshold—every pixel with a value greater than or equal to the threshold gets turned on and every pixel with a value less than the threshold does not get turned on.

Note HP Color LaserJet 5 and 5M printers do not support user-defined dithers. When a Download Dither Matrix command is sent, the printer parses and discards the matrix data and selects the continuous tone smooth 150 lpi algorithm instead.

Download Dither Matrix Command

The Download Dither Matrix command specifies a single matrix for all three primary colors, or three matrices (one for each primary), which may have different sizes and contents.

E_C***m#W**[data]

= Number of bytes of byte-aligned binary data in the data field

Default = 0
Range = 7 to 32767 (command is ignored for values of 0 – 6; values larger than 32767 or device limits are clamped; signs are ignored)

A downloaded user-defined dither will not take effect until after explicitly selecting it via a render algorithm command with a value of 9 or 10. However, if the current render algorithm (or last render algorithm received) was a user-defined algorithm (value 9 or 10), then a user-defined matrix will take effect as soon as it is downloaded. In this case, another render algorithm command (value 9 or 10) is not needed to "select" the downloaded user-defined dither matrix. This is due to the fact that the downloaded user-defined dither algorithm is the currently selected render algorithm.

If the command is sent before downloading a user-defined dither matrix, the device will use the device's user-defined dither default, if available, or, if no default is available, will use the default render algorithm.

Note   The user-defined dither matrix must be defined for processing with additive colors (RGB).

Since user-defined algorithms cannot be used when a device-independent color space is active, trying to specify a user-defined algorithm in this situation causes the default algorithm to be used. The default is used until the algorithm is changed to something other than user-defined, or until you specify a device-dependent color space.

The table below shows the format for a dither matrix that is applied to all three color primaries. The format for "multiple dither matrices" is supplied after this explanation. ("uint 16" means unsigned 16-bit integer; "ubyte" means unsigned byte.)

Byte	15 (msb) 8	7 (lsb) 0	Byte
0	Format = 0	Number of planes = 1	1
2	Dither matrix height in pixels (uint 16)		3
4	Dither matrix width in pixels (uint 16)		5
6	byte #0 (ubyte)	byte #1 (ubyte)	7
8	byte #2 (ubyte)	byte #3 (ubyte)	9
	•		
	•		

Format

This byte should be set to 0.

Number of Planes

This byte designates how many dither matrices are specified by the
command. The command is ignored and the data discarded for any
value other than 1 or 3.

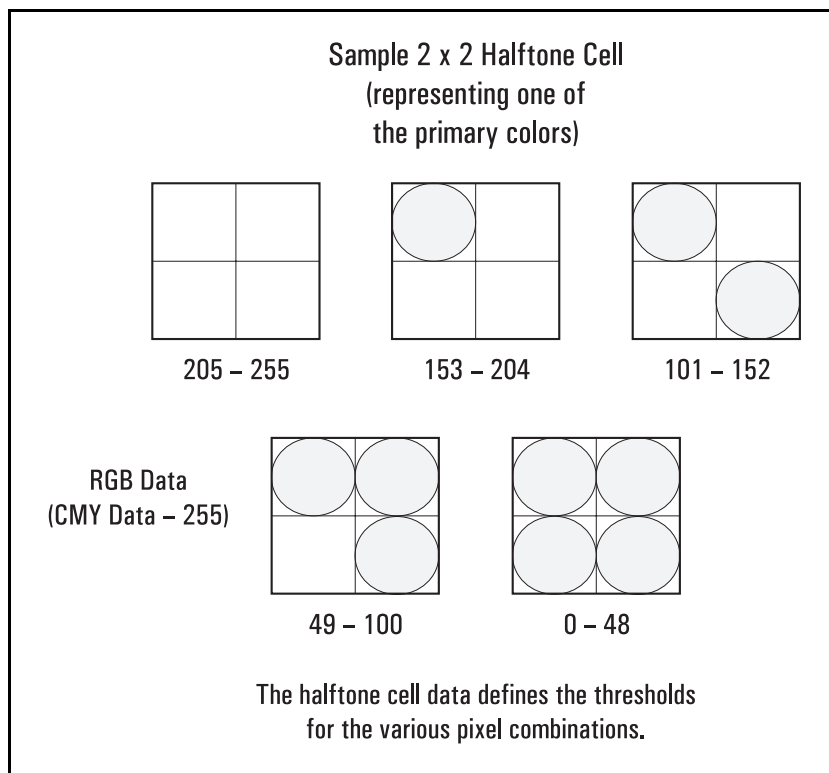| Byte Value	Value Description
1	One matrix applied to all primaries
3	Each primary has a separate matrix

Height and Width

These bytes designate the size of the dither matrix in pixels. For
example, a value of four for height and six for width produces a dither
cell that is four pixels wide by six pixels high. Values must be non-zero
and sized so the matrix contains no more than 32767 bytes.
Otherwise, the command is ignored and the data discarded. The
minimum dither matrix size is 1 x 1.

Data Bytes

After specifying the height and width of the cell, data bytes are sent
row-by-row (row-major order). Each data byte contains the
normalized probabilities, ranging from 0 to 255, of one cell.

For example, a 2 x 2 cell could have no pixels print for RGB values of
205 through 255, one pixel for values of 153 through 204, two pixels
from 101 through 152, three pixels for 49 through 100, and all four
pixels between 0 and 48 (see the illustration below, which represents
a halftone cell for one of the primary colors—note that the color data
is in RGB values).

Sample 2 x 2 Halftone Cell
(representing one of
the primary colors)

205 – 255   153 – 204   101 – 152

RGB Data
(CMY Data – 255)

49 – 100   0 – 48

The halftone cell data defines the thresholds
for the various pixel combinations.

Each dither matrix must be completely specified. Otherwise, the width and height values may be misinterpreted if multiple matrices are sent.

If the width, height, and data specifications result in an odd number data bytes, the next matrix specification will begin on an odd byte boundary. No padding is provided for even-byte aligning.

Multiple Dither Matrices

As noted in the previous table, you set the number of planes field to 3 to send separate matrices for each primary. Each dither matrix must have its own width and height data fields. As shown below, the matrix specification for each primary follows the previous primary color's matrix specification.

Byte	15 (msb) 8	7 (lsb) 0	Byte
0	Format = 0	Number of planes = 3	1
2	Dither matrix height in pixels (uint 16)		3
4	Dither matrix width in pixels (uint 16)		5
6	byte #0 (ubyte)	byte #1 (ubyte)	7
8	byte #2 (ubyte)	byte #3 (ubyte)	9
	•		
	•		
n	Dither matrix height in pixels (uint 16)		n + 1
n + 2	Dither matrix width in pixels (uint 16)		n + 3
n + 4	byte #0 (ubyte)	byte #1 (ubyte)	n + 5
n + 6	byte #2 (ubyte)	byte #3 (ubyte)	n + 7
	•		
	•		
m	Dither matrix height in pixels (uint 16)		m + 1
m + 2	Dither matrix width in pixels (uint 16)		m + 3
m + 4	byte #0 (ubyte)	byte #1 (ubyte)	m + 5
m + 6	byte #2 (ubyte)	byte #3 (ubyte)	m + 7

Example

This example produces a 4 x 4 dither matrix that is applied to all three color primaries (the number of planes is set to 1). The following command would be sent to create this dither matrix:

E_C*m22W010404B0B1B2B3B4 . . . B15 (where the first 6 binary bytes are shown as ASCII here for clarity, and B1 . . . B15 indicate the binary byte data).

The byte-aligned binary data field (shown as ASCII for clarity) would be:

Byte	15 (msb) 8	7 (lsb) 0	Byte
0	0	1	1
2	0	4	3
4	0	4	5
6	B0	B1	7
8	B2	B3	9
	•		
	•		
20	B14	B15	21

Note   Do not use downloaded dither matrices as patterns since the orientation of the pattern will not rotate with changes in orientation and page rotation.

Note   HP Color LaserJet 5 and 5M printers do not support the Download Dither Matrix command. When this command is sent, the printer parses and discards the matrix data. The printer selects the Continuous Tone Smooth 150 lpi algorithm instead.

Color Lookup Tables

Color lookup tables provide a way to re-map color data for the following types of applications:

- Highlight and shadow modification
- Saturation and desaturation
- Unique gamma correction curves
- Special effects for tonal correction
- Neutral balancing

Color lookup tables map input data for each primary color into a new output range based on point-by-point conversions. Color lookup tables can modify input data for both device-dependent and device-independent color spaces.

Like the CID command, the first byte of the data field identifies the color space to which the lookup tables will be applied. These tables specify on a point-per-point basis a transformation from an input space of 0 . . . 255 into an output space of 0 . . . 255. Figure D-1 on the next page illustrates the concept.

The *unity lookup table* (see the following illustration) is the default for all color spaces; it performs a 1:1 mapping of input to output (that is, 129 is mapped to 129). The inversion lookup table performs a simple color inversion; for example, it inverts the red primary of a device-dependent RGB color space to create cyan output (from 255 red to 0 red, which is 255 cyan).

Color Lookup Tables Command

This command enables and specifies color lookup tables.

E_C*ℓ**#W***[binary data]*

      # = Number of bytes of binary data

Default = 0
Range = 0 or 770 (command is ignored for other values; sign is ignored)

A value of 0 resets or initializes the color lookup tables for each primary to the unity curve (1:1). A value of 770 means the data for a color lookup table will be following. The command is ignored and the data is absorbed for any number of bytes not equal to 0 or 770.
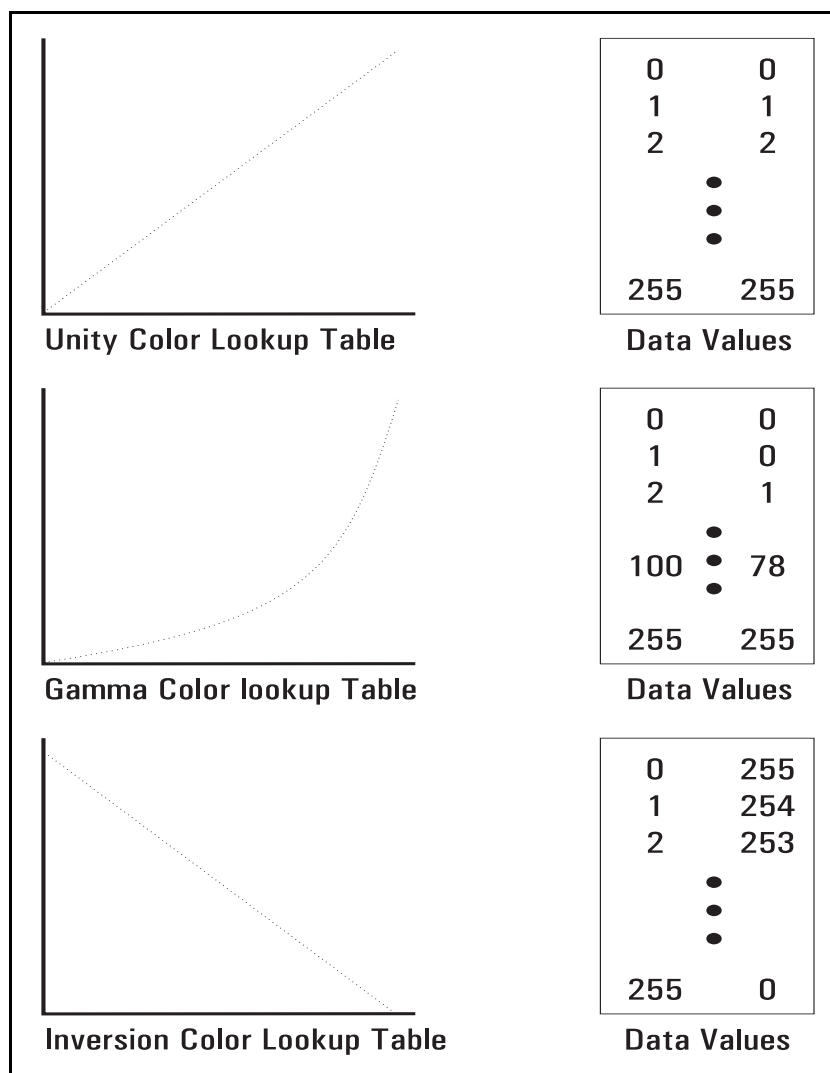
Figure D-1   Color Lookup Tables

This command enables the color lookup tables until an $^E{}_CE$, Configure Image Data (CID), or another Color Lookup Tables command with a 0 value field is received.

Note   RGB gamma correction ($^E{}_C$*t#I) and color lookup tables for device-dependent color spaces are mutually exclusive and overwrite each other.

As shown below, the 256 point-by-point transformation curve for each primary color is defined sequentially for a total of 768 bytes, with the additional 2 bytes for specifying the color space and reserved data field.

Byte	15 (msb) 8	7 (lsb) 0	Byte
0	Color Space	Reserved Data Field	1
2	Color Component 1, Index 1	Color Component 1, Index 2	3
4	Color Component 1, Index 3	Color Component 1, Index 4	5
. . .			
256	Color Component 1, Index 255	Color Component 1, Index 256	257
258	Color Component 2, Index 1	Color Component 2, Index 2	259
260	Color Component 2, Index 3	Color Component 2, Index 4	261
. . .			
512	Color Component 2, Index 255	Color Component 2, Index 256	513
514	Color Component 3, Index 1	Color Component 3, Index 2	515
516	Color Component 3, Index 3	Color Component 3, Index 4	517
. . .			
768	Color Component 3, Index 255	Color Component 3, Index 256	769

Byte 0 (Color Space)

Value	Color Space
0	Device RGB (default)
1	Device CMY
2	Colorimetric RGB Spaces
3	CIE L*a*b*
4	Luminance-Chrominance Spaces

A color lookup table can be attached to one or more of the color spaces anytime after a CID command. For example, a Luminance-Chrominance space can have four lookup tables specified, namely:

- Device-Dependent space
- CIE L*a*b* space
- Colorimetric RGB space
- Luminance-Chrominance space

A reset (^E_CE), IN, or CID command sets each of the four levels of color lookup tables for each primary to the unity curve.

Gamma Correction

Color monitors, which are by nature non-linear, appear incorrect when given a linear ramp of some color. Gamma correction can significantly improve perceptual correctness by adjusting the brightness or darkness of the color data sent from the monitor to any other non-linear device.

Gamma Correction Command

^E_C*t#l

= Gamma number

Default = 0 (gamma correction off)
Range = 0.0 to 32767.0 (command is ignored for invalid values)*

* The practical range for gamma values is 0.0 to 4.0.

Assuming 8 bits per primary (256 intensity levels per primary), the corrected intensity for each color primary is calculated as follows:

$$\text{Intensity} = 255 * \left\{ \frac{Input}{255} \right\}^{\frac{1}{y}}$$

Gamma correction is referred to in terms of device- dependent RGB. This command does not destroy the contents of device-dependent color lookup tables, but setting a gamma value supersedes any lookup table input in either Device CMY or Device RGB.

Note The default value (0) gives the same result as a gamma value of 1.0, which results in a unity gamma curve.

Viewing Illuminant

Printed colors undergo a hue shift when viewed under different illuminations (for example, fluorescent, tungsten, or daylight). Colors with spectral characteristics outside the range of an illumination source are not received, changing the appearance of mixed colors. The Viewing Illuminant command (E_C*i#W) supports communication of standard illuminations to the printer to allow the printer to compensate for different lighting conditions when appearance matching.

Viewing Illuminant Command

The Viewing Illuminant command specifies the relative white point used in the determination of a viewing illuminant condition.

E_C**i#W***[binary data]*

= Number of binary bytes of data

Default = 8
Range = 8 (command is ignored for invalid values; signs in the value field are ignored

The binary data field is formatted as follows:

Byte	15 (msb) 8 7 (lsb) 0	Byte
0	x chromaticity white point (lsw)	1
2	x chromaticity white point (msw)	3
4	y chromaticity white point (lsw)	5
6	y chromaticity white point (msw)	7

The above firnat adheres to the IEEE floating point format as follows:

31	30 23	22 0
Sign	Exponent	Fractional Portion

The PCL default viewing illuminant is D65 (6500K). Below is a table of viewing illuminants and their chromaticity values.

Illuminant	x chromaticity	y chromaticity
Daylight (D65) (6500K)	0.3127	0.3290
Tungsten (3200K)	0.4476	0.4074
Cool White Fluorescent (5630K)	0.3904	0.3914

This command affects only device-independent color. The command acts like a state variable: it is ignored for White/Black, Device RGB, or Device CMY palettes, but it becomes active when a new CID command specifies a device-independent color space.

Monochrome Printing

The *Monochrome Print Mode* command converts each color value to its grayscale equivalent. This improves throughput, costs less to print, and eliminates waste by providing a draft mode.

Monochrome Print Mode Command

The Monochrome Print Mode command designates whether to print using the current rendering mode or a fast gray-scale equivalent. Pages printed using the gray-scale equivalent do not use any color and therefore print faster and more economically.

^EC**&b#M**

 # =   0   -   Print in mixed render algorithm mode
         1   -   Print using gray-scale equivalent

Default   =   0
Range   =   0, 1 (command is ignored for invalid values)

This command must be sent prior to printable data; otherwise, the current page is closed and printed. It may be sent on a page-by-page basis.

Driver Configuration Command

This command specifies the Lightness, Saturation, and Scaling Algorithm to be applied to the document, and allows for the selection and downloading of Color Maps.

E_C***o#W**[*device_id function_index Arguments*]

= Specifies the number of bytes to follow (device ID function index arguments)

Default = N/A
Range = see description below

device_id

Value	Printer
6	Color LaserJet printer

function_index

function_ index	Description	Argument Range	
0	Lightness	-100 to 100	
1	Saturation	-100 to 100	
3	Scaling Algorithm	0	Pixel Replication
		1	Bilinear Interpolation
		2	Modified Bilinear Interpolation
4	Select Color Treatment	0	No Adjustment[1]
		1	Process Blue[1]
		2	Vivid Graphics[1]
		3	Transparency
		4	Out of Gamut
		5	CIE Lab Match
		6	Screen Match

function_ index	Description	Argument Range	
5	Download Color Map	1	CMY Color Space
		3	CIE Lab Color Space
		See MapID List (14739 bytes)	

[1] For the original Color LaserJet printer, the color treatment arguments were slightly different: (0 — Process Blue, 1 — Vivid, and 2 — Business Blue).

The following paragraphs describe the *function_index* values and their arguments.

Lightness

Negative values darken (unlighten) the image, text or graphics color, but do not have any effect on black or white data. Positive values lighten the image. Zero turns the lightness adjustment off. This function index requires three data bytes.

Saturation

Negative values desaturate (add gray to) the image, text or graphics color, but will not have any effect on black or white data. Positive values increase the amount of saturation, making the image more vivid. Zero turns the saturation adjustment off. This function index requires three data bytes.

Scaling

Pixel replication is a backward-compatible scaling algorithm. Bilinear interpolation is a high-quality scaling algorithm for smooth-edge interpolated scaling. Modified bilinear scaling only interpolates when it is best to do so. This function index requires three data bytes.

Select Treatment

This value specifies which color treatment mode to use for rendering the next job.

No Adjustment

This setting provides linearization only (that is, the user sees the device as a linear device).

Process Blue

This setting provides the same results as Vivid Graphics (linearization plus user-preferred enhancements) with the addition of mapping process blue, which looks slightly purple, to a blue closer to that of a standard monitor. This setting is not supported by HP Color LaserJet 5 and 5M printers.

Vivid Graphics

This setting adds color saturation to the resulting image.

Transparency

This setting uses a map to render the best color output on transmissive media. This setting is not supported by HP Color LaserJet 5 and 5M printers.

Out of Gamut

This setting prints colors in an image that are out of gamut—all colors that are in gamut snap to white, all out-of-gamut colors are snapped to the gamut surface. This setting only supports the device-independent color map. This setting is not supported by HP Color LaserJet 5 and 5M printers.

CIE L*a*b* Match

This map performs a true color match to the requested CIE L*a*b* input (there are no appearance matching adjustments). This setting only supports the device- independent color map. This setting is not supported by HP Color LaserJet 5 and 5M printers.

Screen Match

This setting produces a simulated Colorimetric RGB effect of device independent color to match the color to a Sony Trinitron monitor while operating out of a device dependent color space. This setting is supported only by HP Color LaserJet 5 and 5M printers.

Note   For screen matching, the long form of the Configure Image Data command is used and the color maps are generated internally dependent upon the monitor calibration data (the Driver Configuration command is not needed).

Download Color Map

The printer supports the downloading of color adjustment maps dependent upon the halftone requested, the type of color treatment desired (including device-dependent or independent), and the type of media.

Setting	Description	MapID
Device Dependent		
No adjustment	Cluster-No Adjust-DD	1
	Disperse-No Adjust-DD	2
	Scatter-No Adjust-DD	3
	ErrorDiffusion-No Adjust-DD	4
Process Blue	Cluster-Process Blue-DD	5
	Disperse-Process Blue-DD	6
	Scatter-Process Blue-DD	7
	ErrorDiffusion-Process Blue-DD	8
Transparency	Cluster-Transparency-DD	9
	Disperse-Transparency-DD	10
	Scatter-Transparency-DD	11
	ErrorDiffusion-Transparency-DD	12
Vivid Graphics	Cluster-VividGraphics-DD	13
	Disperse-VividGraphics-DD	14
	Scatter-VividGraphics-DD	15
	ErrorDiffusion-VividGraphics-DD	16

Setting	Description	MapID
Out of Gamut	Cluster-OutOfGamut-DD	17
	Disperse-OutOfGamut-DD	18
	Scatter-OutOfGamut-DD	19
	ErrorDiffusion-OutOfGamut-DD	20
CIELab Match	Cluster-TrueMatch-DD	21
	Disperse-TrueMatch-DD	22
	Scatter-TrueMatch-DD	23
	ErrorDiffusion-TrueMatch-DD	24

Setting	Description	MapID
Device-Independent		
No Adjustment	Cluster-No Adjust-DI	51
	Disperse-No Adjust-DI	52
	Scatter-No Adjust-DI	53
	ErrorDiffusion-No Adjust-DI	54
Process Blue	Cluster-Process Blue-DI	55
	Disperse-Process Blue-DI	56
	Scatter-Process Blue-DI	57
	ErrorDiffusion-Process Blue-DI	58
Transparency	Cluster-Transparency-DI	59
	Disperse-Transparency-DI	60
	Scatter-Transparency-DI	61
	ErrorDiffusion-Transparency-DI	62
Vivid Graphics	Cluster-VividGraphics-DI	63
	Disperse-VividGraphics-DI	64
	Scatter-VividGraphics-DI	65
	ErrorDiffusion-VividGraphics-DI	66
Out of Gamut	Cluster-OutOfGamut-DI	67
	Disperse-OutOfGamut-DI	68
	Scatter-OutOfGamut-DI	69
	ErrorDiffusion-OutOfGamut-DI	70
CIELab Match	Cluster-TrueMatch-DI	71
	Disperse-TrueMatch-DI	72
	Scatter-TrueMatch-DI	73
	ErrorDiffusion-TrueMatch-DI	74