Color Management and RIP Software for Digital Textile Printing
Managing Color for Optimal Results

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If one were to take a print design and digitally print that same pattern from a variety of different printers using the same type of ink sets and printing them on the same cloth, the color results would vary widely. The results might even vary from day to day using the exact same printer and inks.

Needless to say, this can be very troublesome and frustrating to the uninitiated. While new users are quick to point fingers at the technology, color matching accuracy and reproducibility is an operator controlled process through the use of color management systems and RIPs (Raster Image Processors), or printer drivers.

The choices and solutions can be confusing. When shopping for a digital printer, the user must also evaluate a broad range of software and RIP solutions designed to support particular devices. How can the user best evaluate these software systems and distinguish them from the printer in evaluating results?

Digital textile printing color management software must answer three key questions. First, what is the color gamut (range of printable colors) of the system, taking into account the printer, inks and fabric used. Are the desired colors inside the digital printer’s color gamut? And last but not least, how can the system produce all of the colors that are within the color gamut?

It is important to understand which colors are attainable within the limits of specific printers and ink sets. If a printer is incapable of producing a desired color, no amount of color management can make it possible. In addition, there are some colors that can be displayed on an RGB monitor, but not printable using a CMYK device, and vice versa (CMYK representing the Cyan, Magenta, Yellow and Black inks used in process color printing).

Some of the first digital printing systems introduced to the textile industry using CMYK process printing were originally developed for the graphics and paper printing industries. These systems were not well received because the color gamut obtainable in CMYK is considerably smaller than the gamut of spot color inks used in conventional rotary screen printing of textiles.

Process Color Systems

Looking at the different process color printing systems will help to understand the realistic color capabilities and expectations one should have of these systems.

CMYK is a 4-color printing process using 3 subtractive color primaries with black, cyan, magenta, and yellow. The color limitations of CMYK lie in the difficulty to reproduce bright reds, greens, and blues, as well as many of the colors required by the textile industry. The CMYK process is improved by including extra colors that cannot be reproduced by dithering or mixing cyan, magenta, and yellow.

Hexachrome® is a 6-color process printing system developed by Pantone, Inc. to address this issue. In the core of Hexachrome, orange and green inks have been added to modified CMYK inks. These additional colors help to reproduce more brilliant continuous-tone images. Pantone states that the Hexachrome system is capable of accurately reproducing over 90% of the Pantone Matching System® Colors - almost twice the number that can be obtained using CMYK process printing.

The strongest complaints about digitally printed fabric from the textile industry are the visible dither of colors and limited color gamuts compared to traditional textile screen printing. With the introduction of 7, 8, and even 12-color digital printers into the
market, these systems come closer to achieving the results desired by
the textile industry. As a general rule, the greater the number of
colors (not printheads) that are in a printer, the larger the number of
colors that can be reproduced. For example, a 12-color printer with
10 individual colors and 2 light shades will provide a much larger
color gamut than a 12-color printer using CMYK with light shades.
It is important, however, to have a balance of colorants to light
shades to eliminate visible dither. When using textile inks such as
reactive, acid, or disperse, the full potential of these color spaces are
not realized until the colors have reacted with the fabric, which
occurs during post-processing such as steaming and washing.

The hardware and ink options available to the textile industry are a reflection of a growing market that has yet to
develop any standards. As an example, Mimaki and Mutoh printers are available in versions that support both CMYK
and Hexachrome® color systems. The Mimaki can be configured with any 6 or 7 colors as well as CMYK with light
shades or in Hexachrome. DGS offers the Luxor 7, which is a Mimaki printer that supports three different inksets
using CMYK with special colors such as CMYK + (blue + green + gold), CMYK + (blue + gray + gold), CMYK +
(C light + M light + K light). In addition, the ColorSpan 12 color printers can be configured as either CMYK with
light shades of cyan and magenta, or use an 8 or 12 color textile inkset. The inks determine the color space, but the
RIP drives and manages those colors.

Digital textile printers are developed, tested and marketed with the use of specific inksets in co-operation with ink
vendors offering inks specially formulated for the textile market. While established users such as fine artists and
graphic designers have been known to stray from these established formulas in hopes of finding their unique niche in
the market, playing with ink chemistries and established ink/hardware formulas is not for the faint at heart. Nor is it
advisable for companies under tight timelines.
Graphic arts RIPs and color management systems support the SWOP color standard for Web-Offset Printing, the color reproduction standard for the digital graphics printing industry. Because this standard uses CMYK process color, SWOP is inappropriate as a color reproduction standard for the textile printing industry, which has used multiple spot colors in conventional printing.

Defining and Profiling Color

CIE L*a*b* color space is one of the color standards used by the textile industry. The CIE, International Commission on Lighting, realized that every color the human eye perceives could be defined using three numbers: L* indicates luminosity, lightness from white to black. The a* and b* are the chromaticity coordinates that indicate color directions: +a* is the red direction, -a* is the green direction, +b* is the yellow direction, and -b* is the blue direction. The center is achromatic, hues of gray. As the a* and b* values increase and the point moves out from the center, the chroma or purity of the color increases. The pythagorean distance between two color points plotted in the color space relates to the visual color difference between those two points. In this way, color variation between points and a standard may be expressed using numbers.
Color management and RIP software manage color by creating profiles or characterizations specific to the printer, ink, fabric and any post-processing, such as steaming and washing. All of these variables have an impact on color and each variation must be profiled to insure accurate color match. When a design is printed, a profile is selected based on the printer/ink/media combination to insure that the colors in the original design or target colors match the digitally printed output.

The process of creating a profile or characterization of a digital printer begins by printing out a linearization file of the inks in the printer, typically from 0-255 saturation. Data on ink density limits can be gathered at this stage as well. These color targets are measured by a spectrophotometer. (See the techexchange.com color library for more articles specific to the color measurement of textiles.) Next, a number of color targets are printed and measured to map the color space of printable colors. From all of these data points an algorithm is used to calculate the color space and the profile is complete.

Various software packages offer different levels of profiling capabilities, from supporting standard ICC profiles created in third-party profiling software, to vendor supplied profiles, to end user capability to create custom profiles using proprietary color systems. The International Color Consortium (ICC) color profile is a standard profile format that characterizes the color-reproduction capabilities or color gamut of devices such as scanners, digital cameras, monitors and digital printers. For a glossary of color science terminology go to http://www.uic.edu/~hilbert/Glossary.html.

The price points of various software packages are often determined by the level of profiling and color management capabilities. For instance, a RIP without profiling capability may be less expensive than one that uses proprietary systems to enable the end user to generate profiles. These options offer color management of digital printing systems to customers who may not want to delve into profiling themselves.

Software Solutions

Textile specific software is needed to handle textile design images, including flat and continuous tone designs, separation files, in addition to color management. Important software features for digital printing of textiles include:

- Accept textile industry file formats from CAD design and screen separation programs: CST, MST, PUB, GRT, SEP, SCN, XPF, etc.
- Accept common graphic file formats: TIFF, Indexed 8 bit TIFF, PSD, EPS, AI, BMP, TGA, etc.
- Print Layout functions such as step & repeat, design coordinates and colorways, color chips, multi-image...
placement, scaling, rotating, spooling or batching, etc.
- Manage expanded ink sets beyond CMYK, depending upon printer
- Ink control functions; Manage higher ink densities required for color saturation of fabric
- Color catalogs, color palettes, and/or Pantone Textile Color System
- Profiling: supplied by vendor or custom profiling capability
- Color gamut visualization and comparison to see if target color is attainable
- Screen Print Simulation features if digital output needs to match to production
- Capability to link color data to the textile mill’s color kitchen

Digitally printed fabric is often seen as too good to be reproduced by traditional screen printing techniques. It is helpful to have screen simulation features to bridge the gap between digital and screen printed fabrics. Several software vendors have incorporated features useful in simulating and matching to screen printed production fabric, such as simulating screen resolution, raster simulation, or screen mesh size; color mixing, color overprinting, and color trapping; incorporating gradation curves for tonal separations; and even profiling the textile printing mill’s color space.

Below is an outline of companies offering color management and RIP solutions for digital textile printing. To decide which color management and RIP software is best for you, determine what your digital printing needs are whether they be proofing, sampling, short run production, and/or matching to screen printing. Also, remember that your color space (gamut) is determined by the ink set.

MatchPrint II from **DGS Dua Graphic Systems S.r.l.**, can manage a range of ink jet printers from 4 to 24 colors. Notable features include:

- Accepts common textile industry and graphic file formats: TIFF, SCN, XPF, GRT, etc.
- Print layout function includes step & repeat, design coordinates, gridlines, arrangement of images, color chips, color correction adjustments, and printing queue.
- High ink saturation capability
- Color atlas, custom color pages
- Printer calibration; custom profiling capability
- Regulation of black tone, esp. interesting for transfer printing

In addition, DGS’s Ramsette III is a range of textile software packages that offer screen print simulation features and generate color recipes for connection to color kitchens. Luxor 7 is DGS’s 7 color digital printing system with Reactive, Acid, Disperse Dyes, Pigments, and Dyes for Transfer Printing. MatchPrint II also supports **MacDermid Colorpan** 12 color printers and the new 8 color ENCAD 850 printer.

**DigiFab Systems** offers Evolution Textile RIP and Evolution Textile RIP PLUS. The Evolution Textile RIP supports a range of printers from HP wide format printers, Roland, Mutoh, Epson 9000, Mimaki TX1600S, and ENCAD 850. Features of Evolution Textile RIP include:

- Accepts common textile industry and graphic file formats: TIFF, BMP, TGA, PCX, PSD, PICT, PUB, etc.
- Print functions include step & repeat, scale, rotate, flip, multiply, mirror, cut, measure, layout capability for presentation boards.
- Edit color capability
- Ink control functions
- Multiple do-undo functions
- Printer calibration: RIP supplies a set of profiles for standard fabric types; supports ICC profiles created by 3rd party software programs

Evolution Textile RIP PLUS adds the following functions:

- Coloring System, colorways, color gradient
- Advanced color management
- Color library/database of colors, custom palettes, color chips
DPInnovations Inc., a subsidiary of Dr. Wirth Software GmbH, offers 3 levels of ProofMaster software, ProofMaster Studio, Mill, and Pro. ProofMaster supports any ink set and a wide range of digital printers such as EPSON Stylus Pro 3000 to 9500, ENCAD TX1500 and PROe series, HP DesignJet series, Mimaki TX1600S & JV2, Ichinose, ColorSpan DMXII & FabriJet XII printers.

- Accepts common textile industry and graphic file formats: Indexed 8 bit TIFF, CST, MST, PUB, GRT, SEP, TIFF, BMP, AI, TGA, PSD, etc.
- Print layout function includes step & repeat, page positioning, scaling, rotating, mirroring, cutting out, color chips, spooling, batching, etc.
- Coloring tools: colorways, color editing, color catalogs
- Color gamut mapping
- Adjustment of colors on multiple substrates, ie non-white fabric
- UNDO function
- Ink control functions: maximum ink level control, user controllable ink mixing
- Printer Calibration: profile wizard to guide end user step by step, vendor provides set of profiles
- Simulation Features: print order, overprint and reservation, trapping, tonal screens such as Penta, Nova, Galvano, Gravure, tonal gradation curve
- Monitor ink level in printer to insure sufficient ink for print job
- Color data link to color kitchen

DuPont Ink Jet introduced a production-capable digital textile printer targeted to the Home Furnishings industry in January 2001. The DuPont® Artistri® Color Control and Management System (CCMS) is the software that drives the DuPont Ink Jet 3210 printer and 8 Color pigment ink set: Black, Cyan, Lt. Cyan, Magenta, Lt. Magenta, Yellow, Orange, and Green. CCMS links the color space of both the digital printer and the textile screen printing mill in order to create digitally printed fabric that matches the textile printing mill. This is accomplished by creating a Mill Characterization and Color Profile of a mill’s unique color set, and a Printer Profile to map combinations of fabrics and ink.

- Accepts traditional textile file formats such as Stork® Public, Stork® Separated, TIFF RGB and TIFF L*a*b* image files.
- Print layout functions
- Printer Calibration: custom printer profiles specific to ink and fabric, mill characterization and color profile
- Gamut mapping to compare ink jet printer gamut vs. textile printing mill gamut
- Screen print simulation features

Textiler from Image Technologies is a dedicated RIP for creating repeat patterns on textiles using the ColorSpan FabriJetXII, Mimaki TX1600S, ENCAD series printers, including the new ENCAD 850, Mutoh, EPSON 7000/7500 and9000/9500 printers.

- Accepts common textile CAD and graphic file formats: TIFF, CDI, Lectra, NedGraphics, HighTex, SpeedStep, Sophis, BMP, EPS, PCX, etc.
- Print functions include step & repeat, colorways, color editing, image positioning, scaling, rotating, mirror, and spooling
- On screen visualization of best color match depending upon output device
- Printer calibration; supports ICC profiles created by 3rd party software programs, linearization capability

NedGraphics offers a range of software modules from design to color calibration, including DeltaNT ColorMatch, a plug-in module for any of the DeltaNT software programs, providing color manipulation, communication, and management.

Vision Simulating Printed Fabric (SPF) is NedGraphic’s software for digital textile printing. SPF supports most fabric printers on the market, including Encad, Mimaki, ColorSpan, HP, Konica, and Iris.

- Accepts common textile industry and graphic file formats: TIFF, Stork, TGA, PS2, etc.
Coloring tools: colorways, color editing, color catalogs, custom catalogs, Pantone Textile Color Library included
- Color gamut mapping
- Preview of design on multiple substrates, using multiple printing and dyeing techniques.
- Step by step UNDO function
- Printer Calibration: custom profile creation by vendor
- Simulation Features: print order, overlapping colors, rasterization, screen mesh, dye type, trapping, pad or resist effects, dye opacity/fabric absorption simulation
- Color data link to color kitchen

SMARTCOLOUR calibration from Sophis supports the Silk Express 6 color printer from RasterGraphics-Gretag, the Mimaki TX1600S, and ENCAD 600 and 60 printers. Sophis offers 5 levels of its Direct Digital Printing (DDP) software. By default, every level includes the following: printer program, printer calibration, printer control, file manager, file import: conversion program, layout editor/colorbook editor, default layouts, DDP networking for multiple computers.

Level I: DDP Server - Viewing Station
- Change step & repeat
- View colors in the design as a reference (8 bit files)
- Create colorways by selecting colors from a colorbook
- Level I runs on the DDP printer server. Levels II- V require an additional computer design station.

Level II: Design Station - Coloration Station
- Coloration functionality, colorways, color libraries
- Input/edit colors using Lab, LCH, or spectral values
- Design operations
- Monitor calibration

Level III: Design Station - Coditex
- Reconstruct existing separations imported from another CAD system
- Simulation features

Level IV: Design Station - Colour Expert
- Same as Level III but with the option to make quality curves to match traditional production.

Level V: Design Station - Liberty
- Level V enables design from a scanned image, to making separations, reconstruct and coloration functions.

PrinterServer software, developed jointly by Lectra Systèmes and Stork, is an interface between computer-generated designs and the digital printing of samples, prototypes, and short run production on Stork digital printers; the Amber, Amethyst, Zircon, and TCP 4000 printers.
- Accepts files from Stork, Lectra, and other CAD systems, as well as TIFF files
- Print functions include step & repeat, job queuing, spooling, multiple image layout
- Color gamut mapping
- Printer calibration: custom calibration profiles, vendor supplied profiles
- Screen simulation features
- Color data link to color kitchen
- Network to multiple CAD stations

The Repeats option for Wasatch SoftRIP, a popular graphic arts RIP, handles textile designs created in dedicated CAD
software, as well as in popular applications such as Adobe PhotoShop. This software supports a variety of ink jet printers including the EPSON Stylus 3000 to EPSON 10000, ENCAD printers, the MacDermid ColorSpan DMXII, HP DesignJet printers, as well as Mimaki, Mutoh, and Roland printers.

- Accepts common graphic file formats such as TIFF, EPS, PDF, PSD, IA, etc.
- Print functions include step & repeat, color editing, layout features
- Supports both indexed color and photographic imagery, within same print file
- Color catalog, colorways
- Printer calibration, supports ICC profiles

The color management and RIP software options available to the textile industry reflect a growing market and growing acceptance of digitally printed fabric for proofing, sampling, and short-run production. It is no longer enough to be able to print fabric digitally, the industry is requiring color matching and management throughout the complete design workflow, from scanning, to calibrated monitors, spectrophotometers, to the digital printer. Future hardware and software developments for the textile industry may include combinations of spot and process printing systems, and customization of a wider range of ink colors that can be selected depending upon the color space requirements of the design to be printed. With all of these future developments, the color management and RIP software will be the engine that drives these systems.

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