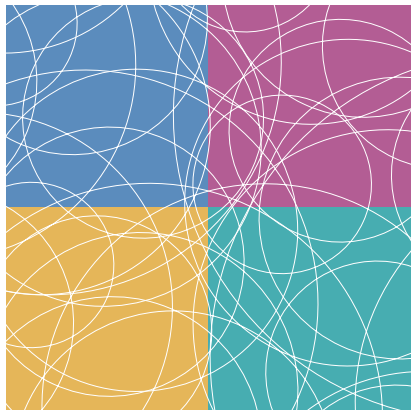
SCREEN
INNOVATION & RELIABILITY

Spekta 2

Technical Guide



A Revolutionary Screening Method for the Digital Age

Dainippon Screen's Spekta 2 is an innovative hybrid screening method that eliminates moiré and broken lines and delivers print quality and detail comparably to that achieved with 300+ line high-frequency screening, all without the need to make special changes to existing conventional print management facilities. Spekta 2 provides high-end print quality using standard CTP equipment.

What is Spekta 2?

Characteristics of AM and FM Screening

The digital revolution has brought a sea change to the prepress world, but the nature of the final printed product has hardly changed at all. Most color print matter with strong visual elements, such as brochures, pamphlets and magazines, is still printed using the same conventional 175 lpi Amplitude Modulation (AM) screening methods that were used before the digital revolution.

Conventional AM screening reproduces light and darkness by varying the size of halftone dots. It is currently the screening method used most often in printing, because the pitch and angle of the dots are fixed, and the method achieves consistent tonal reproduction.

Nevertheless, AM screening has drawbacks. Because the halftone dots are evenly spaced and at angles, AM screening is prone to moiré resulting from factors such as plate misalignment and interference patterns between screen angles and images. Other typical problems include jaggedness and segmenting of fine lines and tone jumping in gradation areas. These kinds of problems are particularly troublesome because they are generally not detectable prior to printing. These problems have also hindered the transition to fully digital workflows, the adoption of computer-to-plate (CTP), and the streamlining of the color proofing process. Efficiency-boosting measures such as direct digital color proofing, or using a color printer for proofing, remain problematic because of the risk of overlooking problems such as moiré.

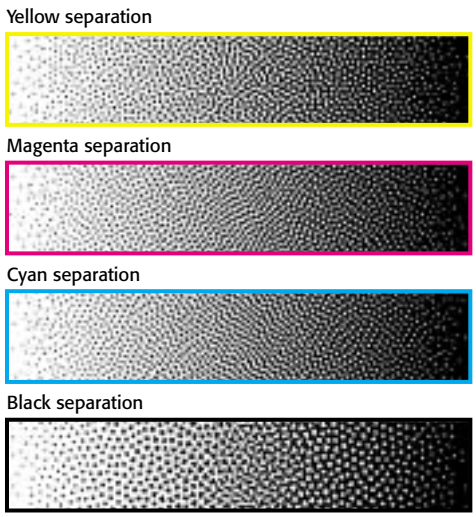
Trying to achieve higher print quality by using higher frequency AM screen rulings also has drawbacks, since printing with high-frequency screening requires much stricter print management conditions. This is why only a small minority of printers use high-frequency screens of 300 lpi or higher. And despite the spread of powerful graphics software that makes it simple to generate high-resolution data, the most common screening method in use, 175 lpi AM screening, leaves the graphic arts industry largely unable to get the most out of its detailed graphics and images.

Frequency Modulation (FM) screening spent some time in the limelight as an alternative to conventional AM screening. FM screening places microdots of equal size randomly, varying their density to reproduce lightness and darkness. Not only does this approach eliminate the moiré and broken lines associated with AM screening, it also supports higher resolution printing. Unfortunately, FM screening demands a rigorous print production environment, which translates into higher printing costs. Also, in comparison to AM screening, with FM screening it is more difficult to print midtones and shadow areas consistently, and the midtones and highlights tend to appear grainy. Despite its other advantages over AM screening, FM screening's own drawbacks have kept it from being more widely implemented.

Spekta 2: Combining the strengths of AM and FM screening

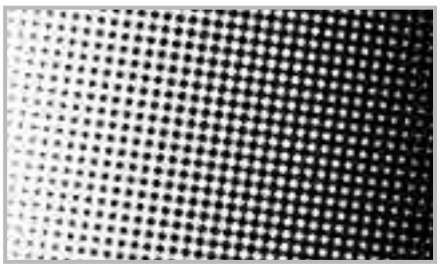
Dainippon Screen has taken the best qualities of both AM and FM screening, and melded them together in an innovative hybrid screening product, Spekta 2. Spekta 2 overcomes the weaknesses of both FM and AM screening, while delivering their key strengths, to make highly-detailed, high-quality printing a reality using ordinary equipment. It uses AM-like dots or FM-like dots depending on the color density of each area being output. By doing so, it achieves the following remarkable characteristics:

1. With the standard 2,400 dpi resolution that is typically used to output 175 lpi AM screens, Spekta 2 achieves a level of detail comparable to high-frequency line screens of 300 lpi or higher. Moreover, it produces no jagged or broken lines.
2. Spekta 2 screening does not generate moiré because it creates no screen angles.
3. It can be printed under standard printing conditions and there is no need to retrain operators.

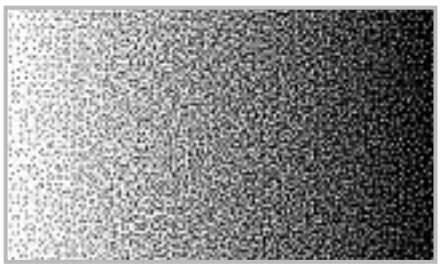


Varying the screening as required for each density range

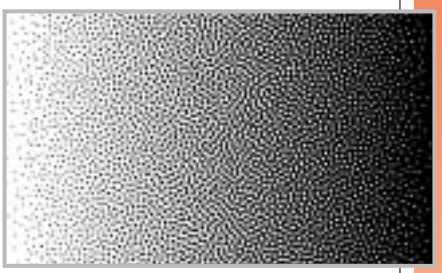
In the 1–10% highlights and the 90–99% shadows, Spekta 2 uses FM screening's fixed dot size and reproduces tone by varying the density of uniform dots. In the 10–90% midtones, it varies the size of the round dots just as AM screening does. The placement of all these dots is random, as in FM Screening, however, which means there are no screen angles to contend with. As a result, Spekta 2 avoids the moiré resulting from factors such as plate misalignment and interference patterns that plague conventional AM screening. Spekta 2 overcomes the difficulty of printing FM screens by setting the size of the smallest dot slightly larger than in FM screens. It also minimizes tone jumping through advanced methods that control the positioning and joining of dots.



AM screening



FM screening



Spekta 2 screening (Y)

Highlights and Shadows

Spekta 2 uses FM screening methods in the highlight and shadow areas. The dots are placed randomly, and tone gradation is expressed through variation in dot sizes. The dots are distributed so that they overlap in some areas, and so that there are no large gaps between them. These methods control the graininess that is the bane of FM screening.

Screen has devoted a great deal of time to determining an appropriate minimum dot size. The smallest dot size that can be output at 2,400 dpi is about 10.5 microns (1/2400 of an inch). This size of dot can be exposed directly onto a printing plate, but handling of dots this small is inconsistent at press, and there is increased risk of visible printing artifacts in the highlight regions. Spekta 2 creates 2 by 2 grids of 4 dots, using dots of 21 microns (corresponding to about 2% of 175 lpi), which is a size that is more appropriate to press capabilities, thereby reducing the risk of print artifacts. This optimizes printing in the highlight regions, while maintaining print stability. Since the dot size used is about 2% of the maximum, by controlling the surface area ratio, changes in tone as small as 0.5% can be expressed, and color output in the highlight areas is extremely smooth.

Midtones

In the midtones, Spekta 2 generally employs random placement of dots, similar to that used in FM screening, but tone gradations are created using AM-screening like methods. In other words, the same number of dots is used at all times, and dot sizes are varied to create tone gradations.

Spekta 2's dot shape is rounded, which yields more predictable results at press. Dot overlap is prevented near the highlight range. What's more, with the latest improved screening patterns, it is possible to control when and where dots join for each contact point. This helps eliminate the effects of dot gain almost entirely between the midtones and the shadows, assuring smooth vignette in this range as well. By preventing tone jumping, Spekta 2 also eliminates the graininess that is liable to occur when different dot sizes are used.

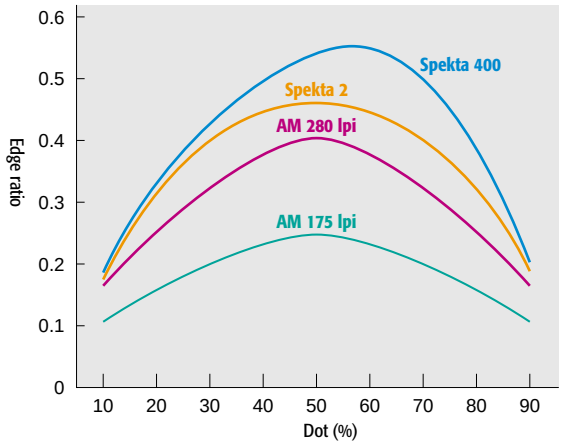
Characteristics of Spekta 2

Halftone dots for high-precision printing

Spekta 2 produces high-precision output equivalent to 300 lpi output, with much less effort on the part of the printing company. The secret lies in Spekta 2's unique halftone dot usage. In the highlights and shadows, Spekta 2 uses random dot placement similar to that of FM screening, varying the number and placement of the dots to create remarkably smooth gradations. In the midtones, Spekta 2 uses a uniform number of dots, varying their size to increase the richness of tone, but switching to FM-screening-like methods when approaching the limits of the press's capability to lay down dots (and thereby avoiding the problems that sometimes arise in areas of extreme density).

The graph to the right illustrates the relationship between dot density and dot surface area. As you can see, Spekta 2 is less dot surface and will improve the stability of printing. Spekta 2 screening offers all the benefits of traditional screening methods without the drawbacks, and makes it easy to achieve high precision, high quality printing.

Relationship between dot surface area ratio and dot density



Preventing moiré

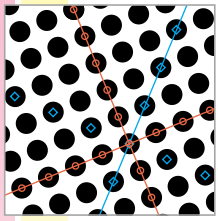


Figure 1: Enlargement, 175 lpi AM dots

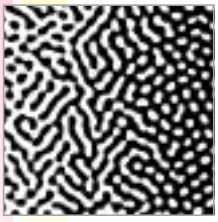


Figure 3: Enlargement, Spekta 2 screening dots

Moiré appears as a result of the interference between repetitive, cyclical screening patterns and patterns within the images being used.* The interference that causes moiré can be eliminated if the problematic repeating patterns within the screening patterns themselves can be controlled.

Here is a simple explanation for why moiré appears during output. Figure 1 is an enlargement of output using AM dots at 175 lpi. The repetitive nature of the output is immediately visible. The actual cyclical quality lies in the period at the second dimension, but for explanation purposes, we are using a one-dimensional model in this example. Figure 2-a is a graph illustrating results when there is no repeating pattern. If there is any repeating pattern, however, the repeating pattern of the halftone dots interferes with the repeating pattern in the image and creates an image of a pattern that is not there – otherwise known as moiré.

Spekta 2 was specially developed to prevent this kind of problem. Figure 3 is an enlargement of an image printed using Spekta 2 screening. As you can see, there is no repeating pattern to the distribution of the halftone dots, so even if there is a repeating pattern in the image being output, no interference occurs, and moiré is not generated.

** During scanning of photographs or image capture using a digital camera, moiré may be generated due to interference between the period of the object being input and that of the input device. In these cases, there is no way to avoid moiré in the output since it is intrinsic to the source image, and not to the output process.*

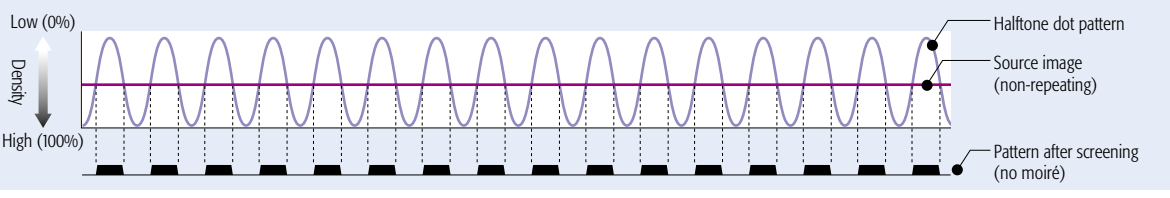


Figure 2-a: Image with no repeating pattern

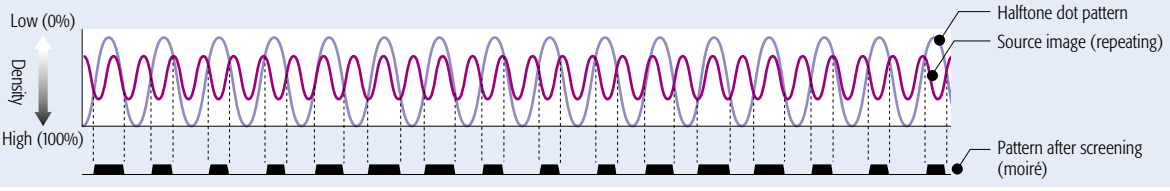


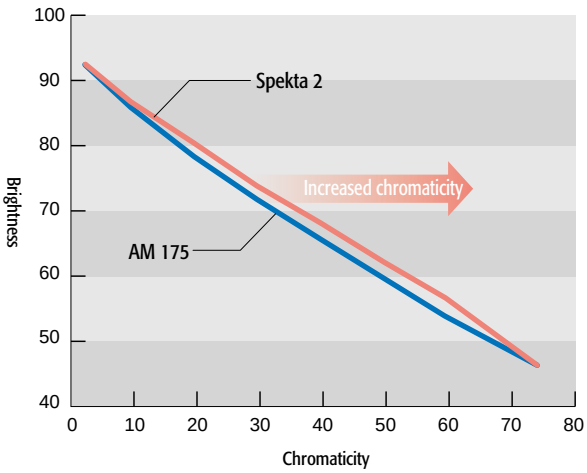
Figure 2-b: Image with repeating pattern

Great color reproduction in the midtones

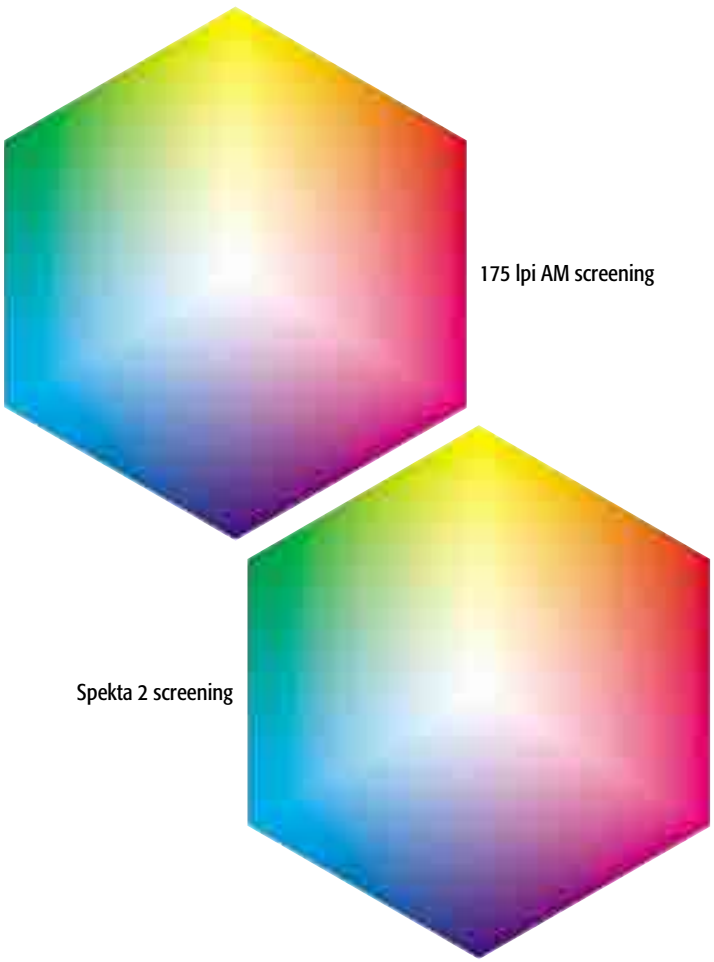
It is commonly observed that as line rulings increase from 100 lpi to 175 lpi or even 280 lpi, the range of colors that can be reproduced increases. It is believed that this happens because as the halftone dots get smaller, their circumference gets larger relative to their surface area, and optical dot gain* around the dots increases, thereby increasing their chromaticity, and increasing the range of colors that can be reproduced. Spekta 2 screening controls the dot shape to maintain increased dot circumferences that enable a larger range of colors, which makes it possible to reproduce more colors than with standard 175 lpi AM screening. There is no difference in the paper or ink density, of course, but the chromaticity of the midtones improves visibly. The hexagonal samples on the right show output using standard 175 lpi AM screening and using Spekta 2 screening. The difference in the midtones is striking.

** Optical dot gain: Increased density around the halftone dot which results from diffusion of light on the printing paper.*

A comparison of 175 lpi AM and Spekta 2 screening



Color reproduction with 175 lpi AM and Spekta 2 screening



Better detail and no broken lines

Since Spekta 2 screening creates a pattern of dots that is uniform but not repeating (cyclical), there are no broken lines, such as are often created by interference with the image when using AM screening. As a result, the details of the image are reproduced more clearly, and even fine lines can be reproduced with excellent results.

Less ink required for Spekta 2 screening*

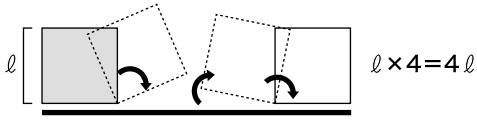
** This effect does not occur in solid areas.*

Spekta 2 screening can reproduce a greater range of midtone colors using a lower halftone dot percentage, thanks to the increase in apparent density that results from optical dot gain. In other words, less ink is required than with standard 175 lpi AM screening.

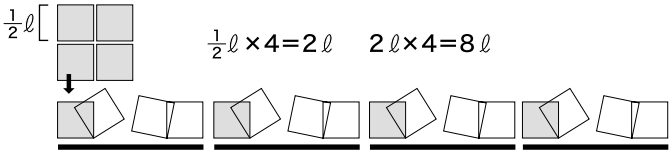
About dot gain

Generally, the amount of dot gain increases as the line screening increases. This is because dot gain occurs mainly around the circumference of the halftone dots. As the line screening increases, and the lines get narrower, the dot circumference increases relative to the surface area of the dot (as shown in the figure below), and the amount of dot gain also increases.

Circumference at 150 lpi



Circumference using the same surface area, but at 300 lpi

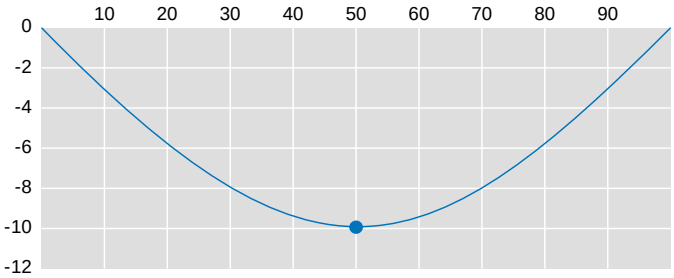


Recommended dot curve for Trueflow

In order to achieve the same gray balance with Spekta 2 as with standard 175 lpi output, recommended dot gain curve to use in Trueflow as illustrated below.

Since thermal CTP output devices use lasers to burn high-precision halftone dots onto printing plates, there should be almost no spread at the plate. With the recommended dot gain values provided by Spekta 2, you will get the same gray balance in 175 lpi and Spekta2 printing .

For Trueflow



	0	2	5	10	20	30	40	50	60	70	80	90	95	98	100
Recommended dot gain values for Spekta 2	0							-10							0

- *The above input values are for each color.*
- *It may be necessary to readjust the gray balance for magenta under certain circumstances.*
- *The ideal curve varies depending on the exact printing conditions. Please use the dot gain adjustment procedure described earlier to determine the ideal curve.*
- *Spekta 2 is not supported in HQ RIP*

Adjusting dot gain

Usually you will get a good gray balance if you use the recommended dot gain values shown before. If you cannot get a good gray balance, this section will explain how to adjust the dot gain for Spekta 2, as well as how to achieve better gray balance and tone from the beginning. For this adjustment, you will need a densitometer that can measure the halftone dot percentage in different areas.

1. Create 4 color patches of each of the percentages listed below, and output the plate with 175 lpi dot. If you already know the standard dot gains at 175 lpi, enter them. Print them using your standard densities.

●Gray tone %

C	0	2	5	10	20	30	40	50	60	70	80	90	95	98	100
M	0	2	5	10	20	30	40	50	60	70	80	90	95	98	100
Y	0	2	5	10	20	30	40	50	60	70	80	90	95	98	100
K	0	2	5	10	20	30	40	50	60	70	80	90	95	98	100

●Generic solid printed density

C1.6 M1.5 Y1.3 K1.8

If you do not have your own solid printed density standards, please use these values.

2. Achieve linearization of the plate for Spekta 2 by using the Screen Gradation tool in Trueflow. Use Spekta 2 to output the above patches with a linear dot gain and print with standard solid densities.

3. Measure the halftone dots for the patches in the samples for both standard 175 lpi and Spekta 2.

●Measuring the halftone dot percentage

1) Select the C separation.
2) Make sure to calibrate the white point for paper white and solid density.
3) Measure each step of the patch for both the standard 175 lpi and Spekta 2 samples, and note down the halftone dot percentages for each step.
4) Change to another color and repeat 2) to 3).

** If the densitometer you are using employs Yule-Nielsen coefficients, enter 1.3 - 1.4 for each of C, M, Y, and K.*

4. Subtract the standard 175 lpi values from the Spekta 2 values to determine the dot gain adjustment value for Spekta 2.

Example 71 - 65 = 6
Spekta 2 AM175 DotGain for Spekta 2

5. Enter the values you have calculated into the RIP as dot gain values, and adjust the values slightly so that they create a smooth curve. Print the patches with Spekta 2 again. It is not always possible to adjust the gray balance and tone properly on the first try. Repeating the steps described above two or three times will increase precision.

Checklist for getting the most out of Spekta 2

In order to maintain the highest level of quality possible with Spekta 2, we recommend following the printing environment guidelines listed below. Please feel free to use this as a sort of checklist.

1. Check the condition of the printing press. Pay particular attention to the temperature (it should generally be between 24° and 25°C), humidity (50% to 60%), ink (assure there is no emulsification), water, and dampening fluid, and confirm that there is no doubling. Spekta 2 is a type of high lpi output, so it is affected by the condition of the printing press more than standard AM halftone dot output. Spekta 2 also requires between 15% and 20% less ink, and dampening water levels must be reduced to compensate.

2. Check the condition of the automatic plate processor. The variation between the midtones and highlights is generally greater than with standard halftone dots.

3. Are you carrying out periodic maintenance of your CTP line? Spekta 2 uses FM screening in the highlights, and dirt on the CTP light source can alter the placement of dots in the highlight areas, which can have a negative effect on the results during printing.

4. It is very important to control the halftone dot percentages both on 175 lpi plates and in the printed product. Spekta 2 can be printed in the same environment as standard 175 lpi output. Therefore, you must first establish numerically based control of the 175 lpi environment.

5. Pay attention to the densitometers being used. Some densitometers cannot be used to measure high line screenings. Densitometers are more prone to error with Spekta 2 screening. We recommend that you use a normal densitometer under fixed conditions for your numerical monitoring and control.

This guide was printed using the following:

Printing press: Heidelberg Speedmaster 102F
Paper: Nippon Paper Industries RECYCLED COAT 100
Ink: Osaka Printing Ink Opis 100N
Output screening: Spekta 2
Platesetter: PlateRite 8600

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