— Co-Res SCREENING —

High Definition Output Using Conventional Resolutions

Q & A

Fuji Photo Film

"High definition output requires high output resolution."

"Lowering the output resolution sacrifices the gradation reproduction."

These were accepted rules. But not anymore.

Co-Res SCREENING changes the rules. Used together with CTP, Co-Res SCREENING enables you to output 300 lpi screens using output resolutions in the 2,400 dpi range and 175 lpi screens using output resolutions in the 1,200 dpi range.

Outputting 300 lpi Screens in the 2,400 dpi Output Resolution Range

Q1: ***Is Co-Res SCREENING AM screening or FM screening?***

A1: Co-Res SCREENING is a type of AM screening. "High definition output requires high output resolution" and "Lowering the output resolution sacrifices the gradation reproduction" were accepted rules in the graphic arts. The technology developed to overcome these limitations is a type of AM screening that allows output of 300 lpi screens using output resolutions in the 2,400 dpi range and 175 lpi screens using output resolutions in the 1,200 dpi range.

Users currently producing 175 lpi with output resolutions in the 2,400 dpi range can, based on their output device specifications, choose either to enhance quality by using the same output resolution to output 300 lpi, or to improve productivity by outputting the same 175 lpi using half the output resolution (1,200 dpi range).

Q2: ***Are the image input resolution and input curve used for 300 lpi the same as for 175 lpi?***

A2: Yes. You can use the same input resolution and input curve. Regarding the output curve, you will need to make a dot gain correction curve for each screen ruling.

Q3: ***Why is Co-Res SCREENING limited to a maximum of 300 lpi?***

A3: 300 lpi and 175 lpi plates output by CTP can be printed at the same conditions. Because screen rulings exceeding 300 lpi require advanced printing skills, they have limitations on the market. Moreover, jobs exceeding 300 lpi make up a small proportion of total jobs in the graphic arts.

As the number of CTP installations increases worldwide, our goal is to make 2,400 dpi range – 300 lpi and 1,200 dpi range – 175 lpi printing common on the market.

Q4: ***What does Co-Res SCREENING include?***

A4: Co-Res SCREENING is a software product that contains and controls screen data. When installed on a halftone dot generation device, you can use Co-Res SCREENING with the same operation procedures as your current screens.

Co-Res SCREENING also includes a useful Technical Handbook containing the information required to create dot gain adjustment curves (300 lpi, 175 lpi) for each press.

Q5: ***What halftone dot generation devices are supported?***

A5: CelebraNT RIP and PM System.

Q6: *What is the technology that changes the accepted rules?*

A6: In the graphic arts field, a general rule was that a single halftone dot must be able to express approximately 200 gradations to reproduce images in print. In the 2,400 dpi output resolution range, this results in a theoretical limitation of 175 – 200 lpi [$(2{,}400/(200)^{1/2}) = 170$]. In the 1,200 dpi output resolution range, the theoretical limitation becomes 85 – 100 lpi. Using screen rulings higher than the theoretical limit was expected to result in image quality deterioration caused by insufficient gradation. However, investigation of the characteristics of human eye reveals that it perceives density in a minimum round area of about $(320 – 340\mu m)^2$, which is larger than the area of a 175 lpi halftone dot $(145\mu m)^2$. Based on this, Fuji Photo Film devised multi-template technology that combines various sizes of halftone dots to express midtone densities. With this technology, a single halftone dot expresses 50 – 60 gradations, while producing a smooth gradation equivalent to that of conventional halftone dots that express 200 gradations. Essentially, Co-Res SCREENING represents a fundamental change in conventionally accepted graphic arts principles.

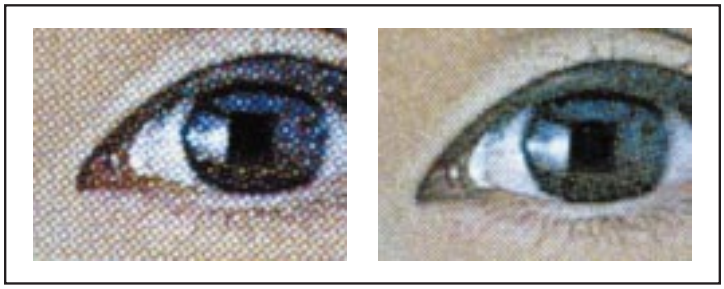


Figure 1 Left: Halftone image (enlarged) produced with conventional technology. The output resolution is 2,438 dpi and the screen ruling is 175 lpi. Right: Halftone image (enlarged) produced with Co-Res SCREENING. Output resolution is the same, but the screen ruling is 300 lpi.

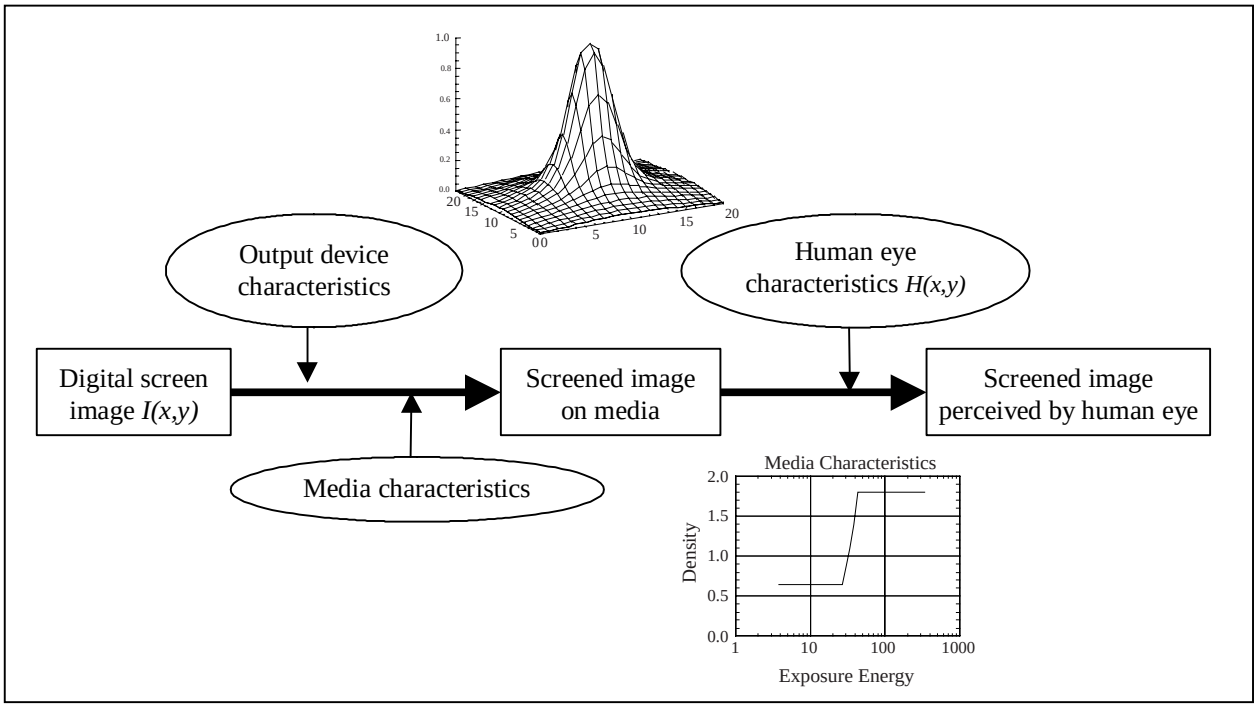


Figure 2 Conceptual Diagram Co-Res SCREENING Simulation

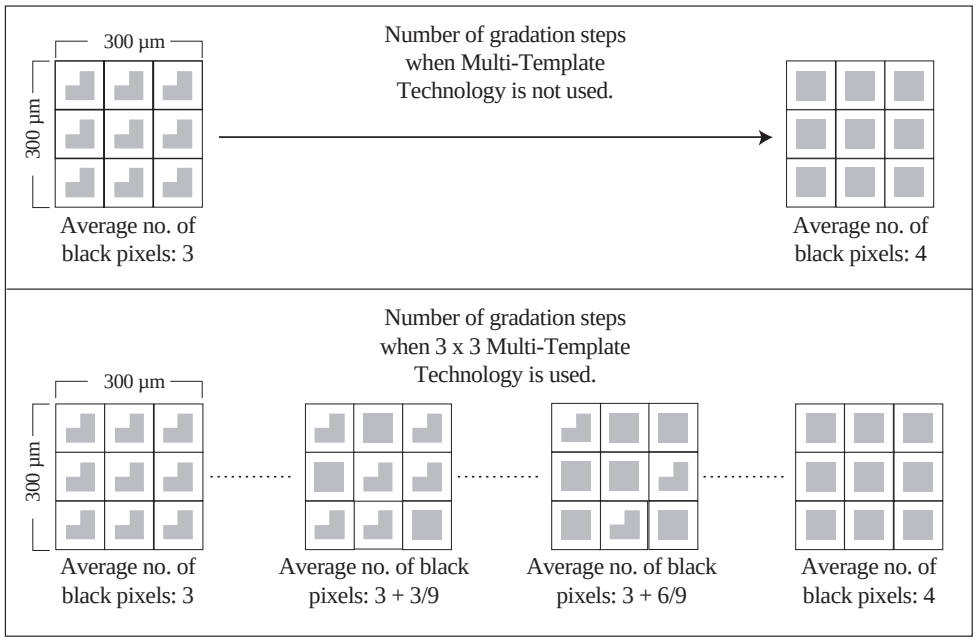
Q7: *What is gradation reproduction using the characteristics of human perception?*

A7: Co-Res SCREENING employs two core technologies that enable production of high screen rulings at low output resolutions. These are (1) *Multi-Template Technology*, based on gradation expression using the characteristics of human perception, and (2) *Output Characteristics Simulation Technology* for suppressing moiré resulting from halftone generation.

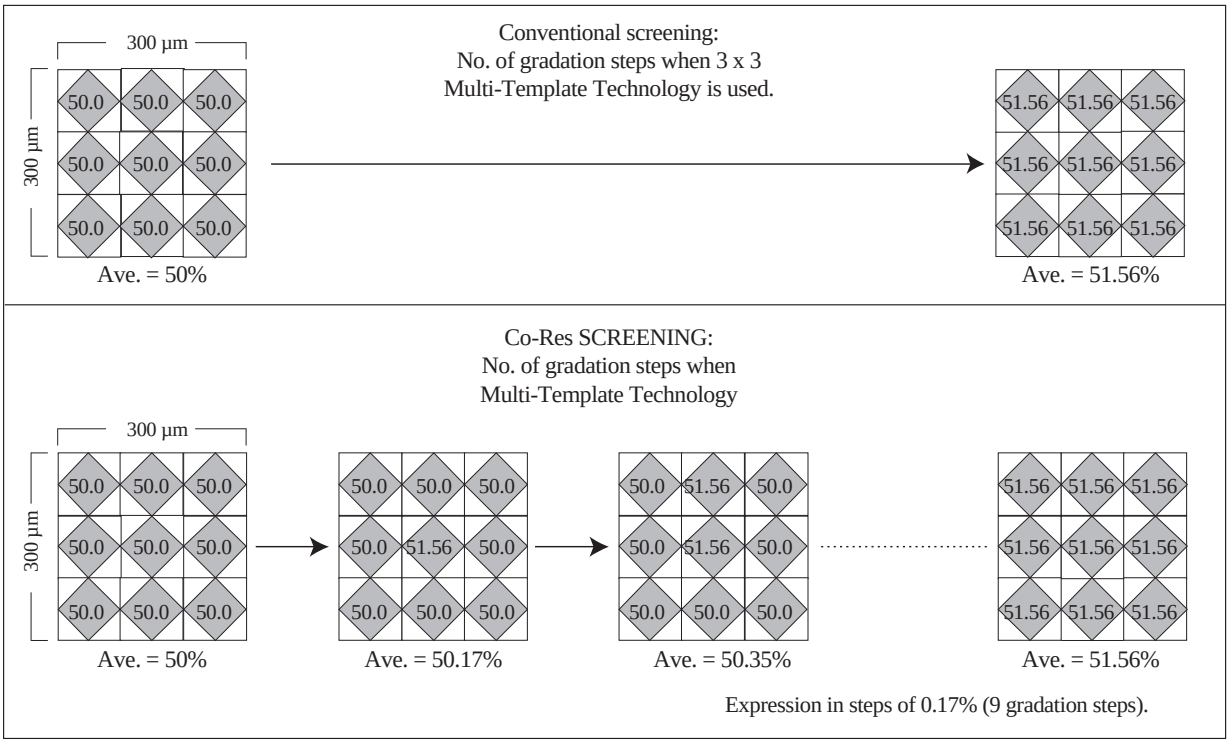
The number of gradations used for expressing gradation with a single halftone dot and the number of gradations perceived by the human eye are different. When expressing the gradation with a single dot, higher screen rulings require higher output resolutions. Problems with higher output resolutions are increased processing time by halftone dot generation devices and limited support by output devices. Moreover, when outputting from remote locations, the larger file sizes increase data transmission time.

When viewing printed matter, the human eye is capable of perceiving density in a minimum area of about $(300\mu m)^2$. This characteristic was used to develop the image processing that forms the basis of Co-Res SCREENING technology.

The effective use of human perception characteristics in this way enables output of high screen rulings at low output resolutions, reducing the amount of data, and therefore yielding significantly improved system productivity. At the same time, image quality is nearly the same as for the same screen rulings at conventional output resolutions.



Multi-Template Technology vs. Conventional Screening - 1 (No. of pixels per halftone dot: 2 x 2)



Multi-Template Technology vs. Conventional Screening - 2 (No. of pixels per halftone dot: 8 x 8)

Figure 3 Conceptual Diagram of Gradation Reproduction

Q8: *What are the characteristics of simulation?*

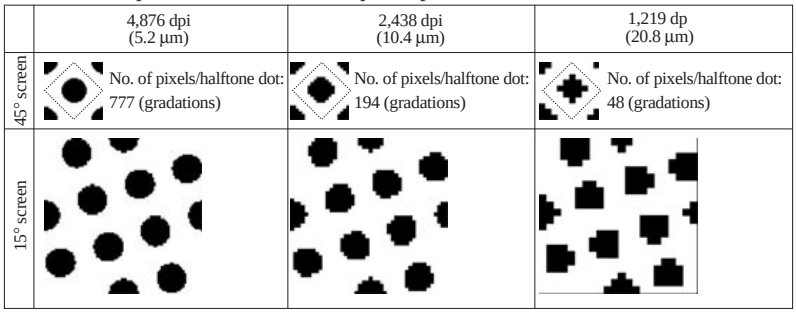
A8: Another major feature of Co-Res SCREENING is its use of an extremely sophisticated theoretical approach. When producing 300 lpi range screens in the 2,400 dpi output resolution range, the biggest technical issue is how to suppress periodic streaks (called single color moiré) generated

by the conflict between the screen frequency and the scanning pitch. With Co-Res SCREENING, a simulation system is configured (see Figure 2) that takes into account the characteristics of CTP materials, the CTP recording beam, and the human eye. This system automatically performs on a personal computer a simulation of both CTP plate-recording and visual evaluation. It then designs screening data that will result in the least observable single color moiré. This system, however, does not rely only on theory. It also determines the correspondence between the actual system and simulation system and performs strict quality evaluations of the resultant screen, a clear demonstration of the suitability of the Co-Res SCREENING concept.

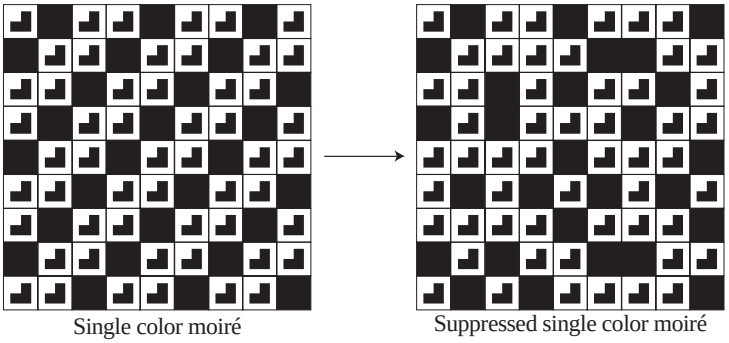
Q9: ***How is single color moiré suppressed?***

A9: As discussed above, generating halftone dots using *Multi-Template Technology* tends to result in single color moiré caused by conflicting halftone dot frequency and output scanning pitch. *Output Characteristics Simulation Technology* was developed to reduce this type of moiré. The basic cause of single color moiré is the regular arrangement of the halftone dots. This new technology effectively reduces single color moiré by predicting this arrangement, and then, taking into account visual characteristics, adjusting the arrangement. For example, when a high screen ruling is produced at a low output resolution, diagonal lines, a type of single color moiré, are generated. Figure 4 shows how single color moiré is suppressed by simulating in advance such moiré.

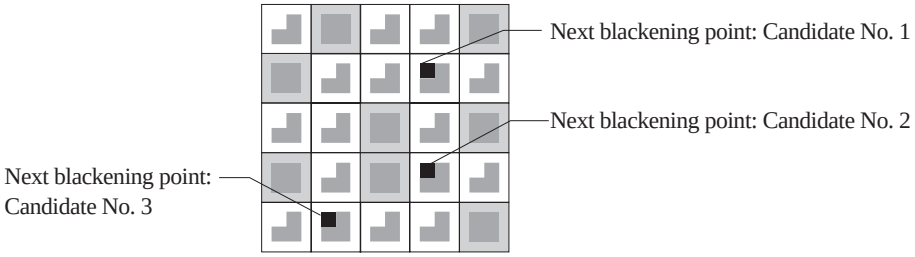
Halftone image: Halftone dots of the same area are arranged at regular intervals. Gradation is expressed by changing the dot area.
Problems:
• Difficult to obtain required number of gradation steps.
• Difficult to place halftone dot in required position at low resolutions.



Enlargement of 175 lpi halftone dots at various output resolutions



Effects of single color moiré simulation



Single color moiré suppression

Figure 4 Conceptual Diagram of Single Color Moiré Suppression

Q10: *How is tone jump prevented?*

A10: Tone jump is perceivable to the human eye when halftone dot intersections become connected simultaneously. The Co-Res SCREENING halftone dot shape is designed to prevent tone jump and dot gain. Specifically, the halftone dot has a round shape that, having shorter borders than a square shape, resists dot gain in the highlight and shadow areas. Tone jump in the 30 - 70% midtone areas is prevented by gradually converting the round shape to a square shape (50%) by increasing the number of pixels. With this type of method, halftone dot intersections connect gradually, yielding image quality with reduced tone jump effects.

Q11: *What are the advantages to Co-Res SCREENING?*

A11: Co-Res SCREENING enables 300 lpi quality at an output resolution range of 2,400 dpi with productivity at 175 lpi levels. Co-Res SCREENING also enables the production of 300 lpi printed matter at the same conditions as for 175 lpi, thus creating added value for printed matter. Also, if the output device's recording speed is faster in the 1,200 dpi range than in the 2,400 dpi range, productivity can be raised while obtaining approximately the same quality as the normally unused 1,200 dpi range and 175 lpi combination. This increases the daily capacity for 175 lpi jobs.

Q12: *How is the market reception?*

A12: Co-Res SCREENING can be installed as an optional screen product on Fuji Photo Film thermal CTP setters (Luxel T-9000CTP series and T-6000CTP series), Fuji Photo Film photopolymer CTP setters (Luxel P-9600CTP), and Fuji Photo Film DDCP (FINALPROOF). Users of these products in Japan have without exception highly evaluated Co-Res SCREENING results. In particular, users of the 2,400 dpi range – 300 lpi combination for thermal CTP have been employing Co-Res SCREENING with great success with printed products requiring very high quality, such as the high-grade monthly periodicals of their valued department store clients.

In addition, Co-Res SCREENING received the Japan Federation of Printing Industries 2002 Technology Award.