



White Paper

Hybrid Gamma Functions and Effects

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Introduction

Diagnostic imaging devices used in medical practice have become increasingly sophisticated at an extraordinary pace with the arrival of MDCT (Multi-Detector Computed Tomography) and high magnetic field MRI (Magnetic Resonance Imaging). Moreover, medical monitors are used to display a variety of images, due to the digitalization of diagnostic image devices and the widespread use of PACS (Picture Archiving and Communication Systems).

Additionally, with the advancement of image processing technology, various images such as 3D and Fusion images, color MRI images, pathology and endoscope images and PET (Positron Emission Tomography) pseudo-color images, are becoming widely used.

In recent years, high performance and high resolution medical monitors, such as 6MP and 8MP models, have been developed. These monitors can simultaneously display multiple images with large amounts of information. Due to this, color medical monitors are increasingly being used to display monochrome images.

With this background, we have developed the RadiForce RX430 with Hybrid Gamma, which is the first function of its kind in the world, and it distinguishes between monochrome and color images and displays each image optimally.

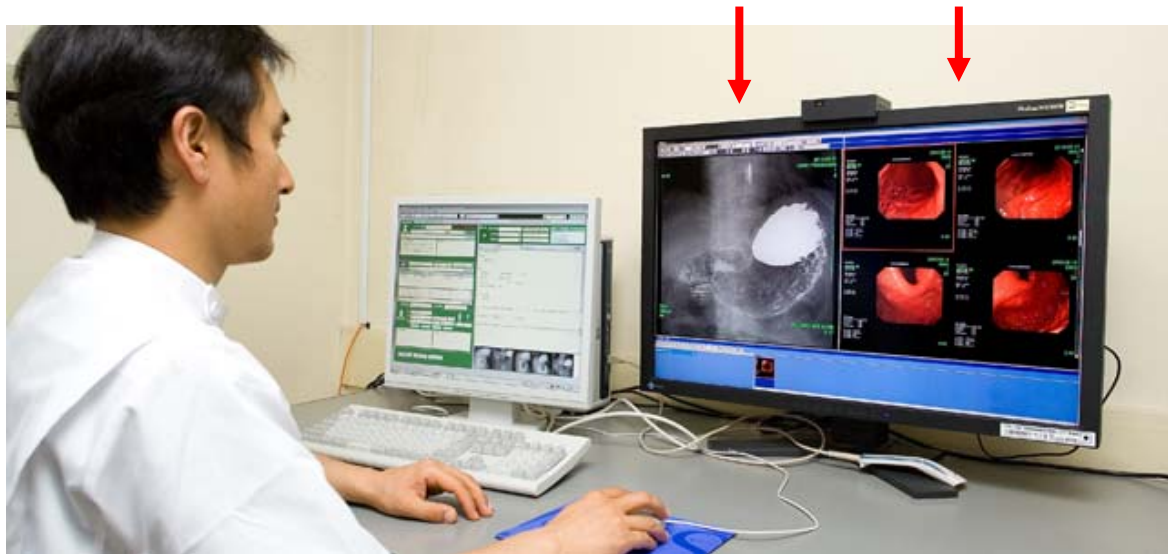
This white paper describes the RadiForce RX430's Hybrid Gamma function (PATENT PENDING), which is a proprietary technology of EIZO.

Problems in Displaying Colors and Monochrome Images

[The display environment of color and monochrome images]

When monochrome images are displayed on color medical monitors, they are shown together with color images or alternately turned into color images, as shown in the photograph below. Therefore, there is a need for monitors to display monochrome and color images optimally.

Monochrome and color images are displayed simultaneously



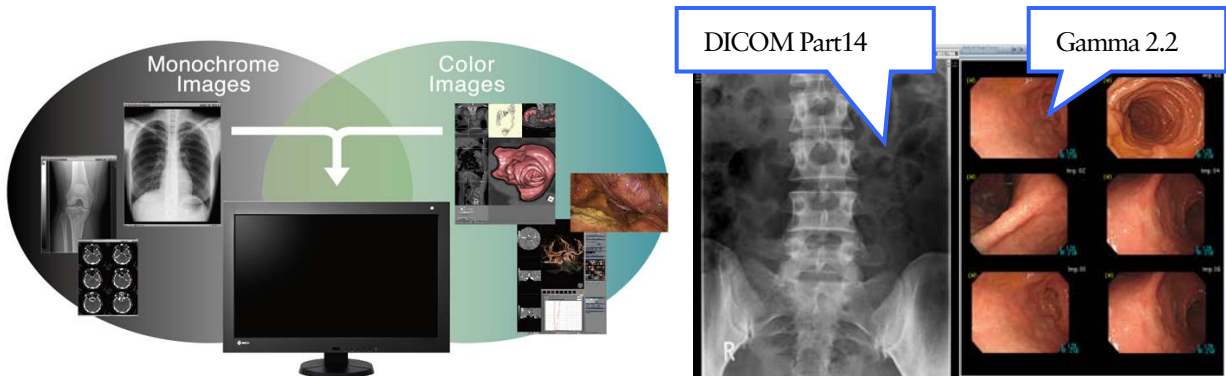
When displaying only a color or a monochrome image, the monitor simply needs to apply a suitable tone to the entire screen. However, when displaying both types of image simultaneously, the problems described on the next page occur.

[Problems in simultaneously displaying color and monochrome images]

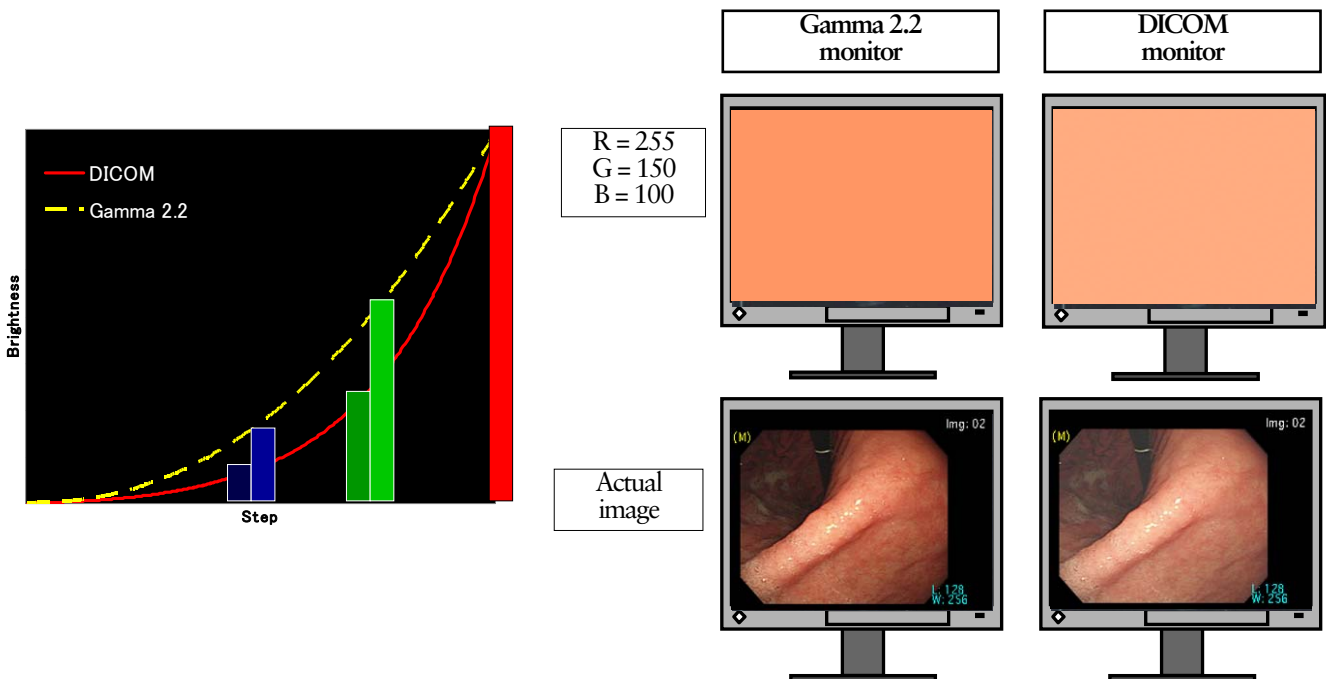
Appropriate tone characteristics for color or monochrome images differ as follows.

Monochrome images: GSDF (Grayscale Display Function) tone characteristics are defined in the DICOM (Digital Imaging and Communication in Medicine) Part 14

Color image: Gamma 2.2



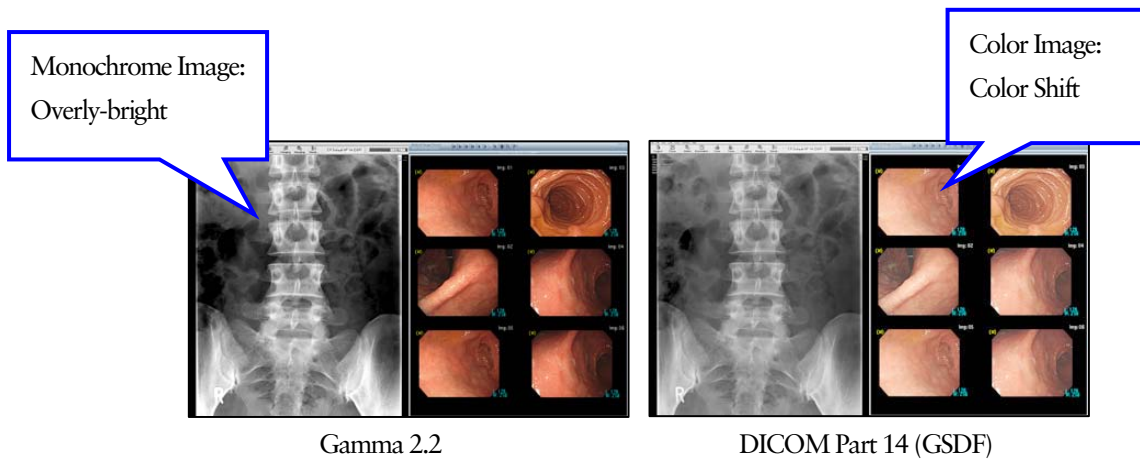
When displaying color and monochrome images, the problem of intermediate color changes occurs as the monitor adjusts to different tone characteristics. As shown in the figure below, when displaying the color R=255, G=150, B=100, it appears differently on color images on a gamma 2.2 monitor and on monochrome images with DICOM tones. In fact, actual endoscopy images appear normal with a gamma 2.2 monitor, however images with a DICOM monitor appear whiter.



At the same time, when displaying monochrome radiography images on color gamma 2.2 monitors, there is a problem in that images appear overly-bright and low tone parts are hard to see.



In this way, displaying color and monochrome images simultaneously on conventional monitors causes color problems such as over-brightness and color shifts.



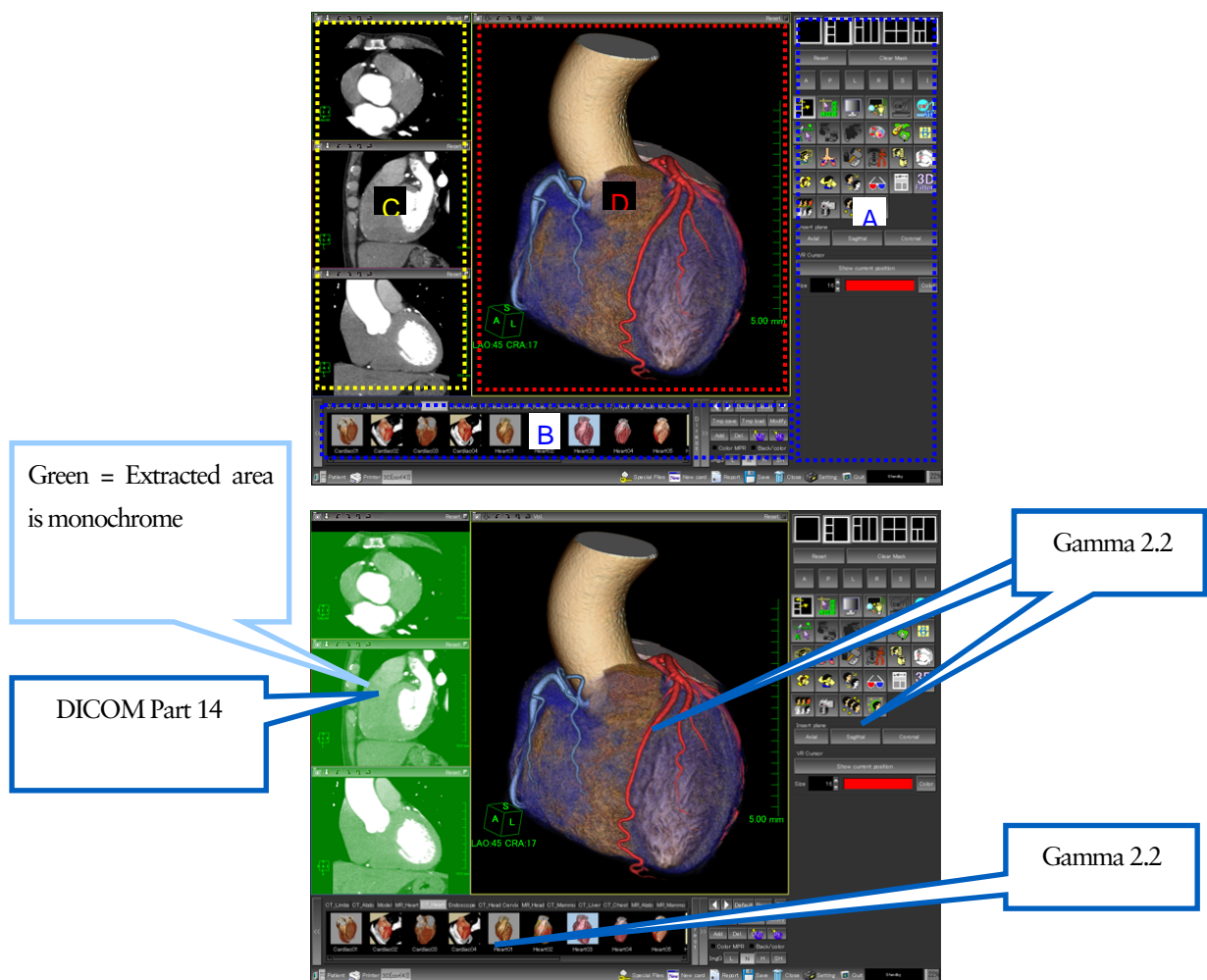
The Hybrid Gamma Function

[Function Overview]

The Hybrid Gamma function is the first function of its kind in the world which auto-detects monochrome and color image areas on a given screen and displays them in appropriate tone characteristics (gamma).

In the figure below, the monitor detects the part of the monochrome images highlighted in green as a monochrome area and other areas as color areas. The monitor then displays DICOM Part 14 (a GSDF tone characteristic) on the monochrome area and gamma 2.2 on the color areas. In other words, the monitor achieves a differentiated tone characteristic display on a single screen.

In the figure below, the screen consists of four areas, A. Menu and control, B. Thumbnail-sized images, C. Monochrome images and D. Color images. The monitor's internal processor recognizes area C as a monochrome area and sets the DICOM tone characteristic for it. At the same time, this processor also detects areas A, B, and D as color areas and sets gamma 2.2 for these areas.



This Hybrid Gamma function can solve the color problems described earlier, such as over-brightness and color-shifts. Thus, Hybrid Gamma is an effective function for working with simultaneously displayed color and monochrome images (PATENT PENDING).

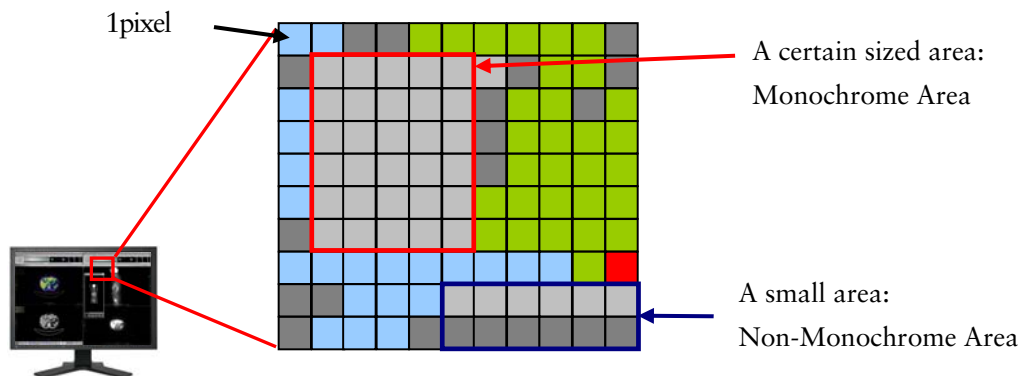
[Mechanism of color and monochrome area detection]

When displaying color and monochrome images simultaneously, the Hybrid gamma function firstly auto-detects a monochrome area of a given size. This function then displays tone characteristics for monochrome images set by OSD (On Screen Display) (DICOM/CAL1/CAL2/CAL3) on the monochrome area. At the same time, this function recognizes all parts outside the monochrome area to be color areas and displays regular custom tone characteristics (Gamma 2.2) on them. Moreover, this function recognizes small monochrome areas as color areas since small monochrome areas tend to be parts of color images or are not used for diagnostic imaging.

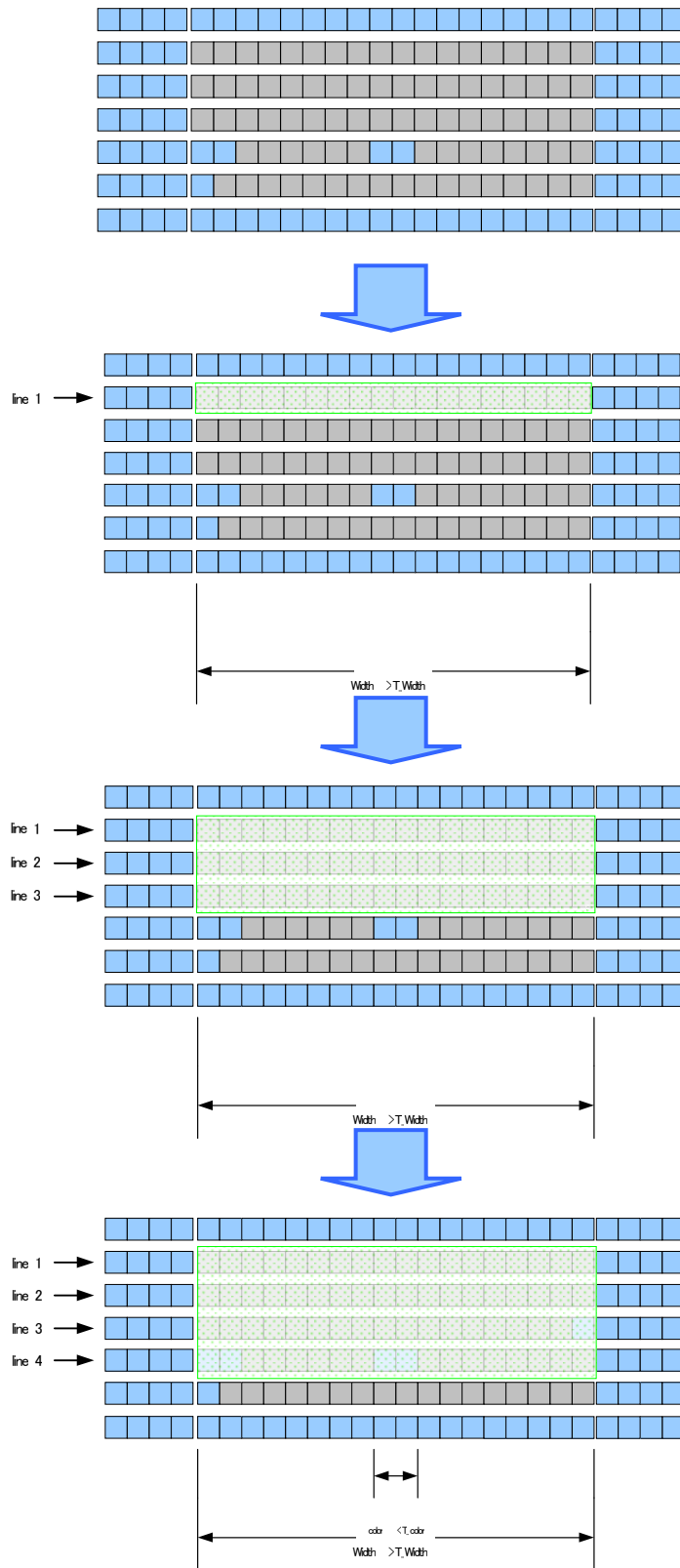
Detection mechanism

- Scanning the image line-by-line to detect monochrome areas
- Detecting monochrome areas above a determined size

NOTE: Standard sizes can be changed with a parameter.



Monochrome Area Detection Algorithm



Monitor scans image to detect monochrome areas line-by-line.

When the number of monochrome pixels is above a determined number, the monitor sets them to be the starting line of monochrome area detection.

The monitor scans line-by-line starting from underneath the start line.

In consideration of color annotations or text, the monitor accepts color areas below a determined size within monochrome areas.

Hybrid Gamma Function Advantages and Effects

The RadiForce RX430, released in November 2010, features the Hybrid Gamma function. Moreover, future releases of RadiForce series diagnostic monitors will include this Hybrid Gamma function.

This function affords the possibility of further application of medical monitors in various new fields in the future as follows:

- Use with sophisticated image viewers
- Assistance in combined digital imaging diagnosis which uses two or more applications simultaneously
- Encouraging the use of super high resolution color monitors and making them widely used
- Application in the combined use of diagnostic imaging and clinical reviews
- Academic purposes such as combined use of text input and medical image display

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