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## DIGITAL PATHOLOGY GUIDE

# The Right Monitor for your Diagnostics



# Why is the choice of the screen crucial?

Not every monitor is suitable for the demanding task of digital diagnostics. There are still no regulations in pathology for the display of digitized slides on monitors. However, there are recommendations, experiences, and foremost criteria to ensure that pathologists can see as much as possible in the digitized slides and that their eyes do not tire quickly.

As "The Pathologists' Company," in this guide, we provide an insight into the world of optimal pathology screens and crucial aspects from image quality to technical performance.

All information is based on our dialog with experts and users from the field of pathology as well as on the „Digital Pathology Guide“ published by the Association of German Pathologists. In the end, you will have a clear guidance.

We will be happy to assist you personally in selecting monitors and other systems for your digital diagnostics workflow.

Your Smart In Media Team





# Resolution

Improving your visual experience is directly related to screen resolution:

- The higher it is, the less pixelated the images appear to you.
- They have more precise contours.
- The content is displayed more clearly.

In a nutshell: As a pathologist, you can get out more of each digital slide.

The resolution of a monitor signifies the pixel count composing the on-screen image. Each pixel stands as the fundamental unit within a digital image. The gauge of a monitor's resolution is the pixel tally (width x height) used to construct the visual output.

A higher resolution is directly related to an improved ability for the user to see details. Particularly, expansive screens endowed with elevated resolutions can accommodate larger volumes of image content, ensuring diminished pixelation and clearer outlines. It's noteworthy, however, that excessively high resolution on a small screen may render text, images, and tools too diminutive for efficient utilization. To

counteract this, users often resort to scaling adjustments in operating system settings, inadvertently leading to imprecise visuals and undesired image artifacts.

Consider a scenario wherein a digitally captured image from a WSI (whole slide image) scanner is scrutinized. Here, a robust resolution is indispensable to retain an optimum level of intricate detail and data, which is crucial for accurate pathological diagnoses. Therefore, the following sizes and resolutions are recommended:

**27-inch-monitor: resolution min. 4 MP (2560x1600)**

**30-inch-monitor: 6 MP (3280x2048)**

**32-inch-monitor: 8 MP (3840x2160)**

#### **DO NOT FORGET:**

In digital diagnostics, pathologists often navigate quickly through the whole slide image (WSI). This means that the image must be built up again and again on the screen in the shortest possible time. To work quickly and smoothly, you need a powerful graphics card.



## Screen Size

When choosing the right screen size, the physical working area and the user's field of vision are the most important factors. In the context of Digital Pathology, the recommended screen size falls within the 27 to 32-inch range, designed to seamlessly encompass the user's natural field of vision.

Opting for a smaller 24-inch monitor would fall short of filling this natural field, while an oversized 55-inch screen would necessitate constant head movement to take in the entire image.

**Extensive experience underscores that practitioners find the most comfort with 27 to 32-inch monitors within the field of pathology.**

This preference stems from reducing the necessity for image scaling, preventing the potential outcome of distorted images and unwelcome visual artifacts.

The aspect ratio of a monitor is directly related to its resolution and refers to the relation between width and height, for example, 4:3. The smaller the margin between the numbers, the „squarer“ the image; a more extensive margin results in the broader display (e.g., 16:9)

**In Digital Pathology applications, an aspect ratio of 16:10 is particularly fitting.** This ratio reflects the appearance of the image under the microscope and corresponds to the natural human field of view.

## Image Brightness

The luminance/brightness of a display is conventionally gauged in candelas per square meter ( $\text{cd}/\text{m}^2$ ), where a single candela approximates the radiant intensity of an everyday candle.

Monitors with brightness levels surpassing  $300 \text{ cd}/\text{m}^2$  are notably well-matched for spaces that bask in ample ambient light, radiating a brighter environment.

A Just-Noticeable Difference (JND) signifies the most minor perceptible alteration in color/brightness discernible to the human eye. Higher monitor brightness yields a more excellent display of JNDs, a critical aspect since an elevated JND count directly enhances the likelihood of detecting minute variations within an image.

**The National Association of German Pathologists underscores a recommended image brightness of no less than  $300 \text{ cd}/\text{m}^2$  for monitors deployed in pathology diagnostics, mirroring the familiarity of a traditional microscope view.**

To ensure long-term brightness consistency, monitors with significantly higher brightness are recommended to protect against device ageing and stricter future brightness guidelines. In well-lit environments, it's imperative to elevate monitor brightness significantly beyond  $300 \text{ cd}/\text{m}^2$  to facilitate the identification of an ample array of JNDs.





# Contrast

The contrast in a monitor pertains to the relationship between the deepest blacks and the brightest whites. To illustrate, a static contrast ratio of 1000:1 signifies that the brightness of an entirely white image is a thousandfold higher than that of an all-black image.

Contrast assumes significance as it ensures the pathologist's ability to discern particulars like cell boundaries and layer distinctions within images.

To secure optimal differentiation between dark and bright sections within images while maintaining control over uniformity, a minimum contrast ratio of 1000:1 (static contrast ratio) is recommended for monitors employed in pathology diagnostics.

In environments with heightened illumination, the genuine light ratio—reflecting the proportion of light between black and white in the scene—can be diminished as the monitor's emitted light masks darker tones. Under such circumstances, minimizing ambient light around the monitor's display is advisable to mitigate this effect.

## TECHNICAL KNOWLEDGE:

To determine a contrast, either the static or dynamic contrast ratio is measured:

1. Static contrast is the ratio of white to black on a monitor without adjusting the backlight (brightness).
2. For the dynamic contrast, the white value is first measured with maximum backlighting, then the black value is measured with minimum backlighting.

Measuring the static contrast ratio gives a more reliable indication of the achievable contrast within an image.



# Image Homogeneity & Refresh Rate

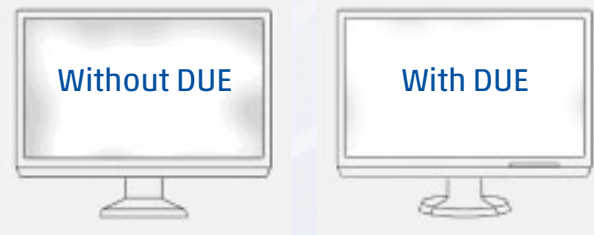
Striking a balance in luminance irregularities across the monitor's expanse is imperative to ensure an entirely consistent image presentation, regardless of its position on the screen.





**Image homogeneity** refers to the consistency of brightness and color across the entire monitor. The key is to minimize possible fluctuations and inconsistencies. While this is not important for office applications, it is essential for diagnostically relevant image content. This is the only way for the pathologist to always see the same image - no matter where it is on the monitor.

A DUE function (Digital Uniformity Equalizer) can be used to compensate for fluctuations in brightness and color. This is integrated into the pathology monitors from EIZO, for example.

A monitor's **refresh rate** quantifies the frequency of new image rendering per second, measured in hertz (Hz). A correspondingly high refresh rate enables smooth navigation in the slide as well as zooming in and out.

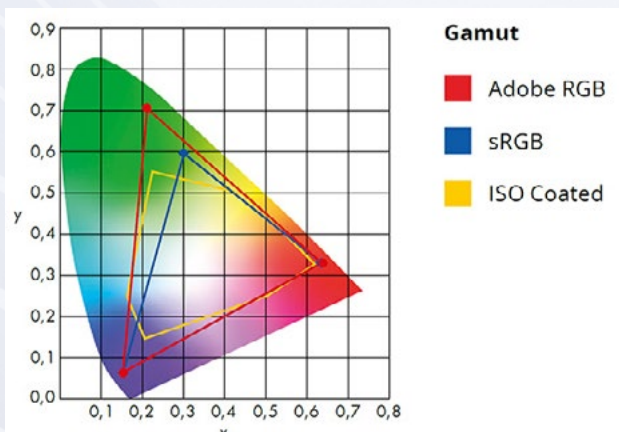
The manufacturer EIZO uses a frame rate of 60 Hz for medical monitors. No recommendation is currently given in the „Digital Pathology Guidelines“ of the Federal Association of German Pathologists.



 <p><b>MX315W RadiForce</b></p> <p>4,096 x 2,160 pixels ensure crisper details across the board. The MX315W correctly displays greyscale tones of radiological images over the entire screen.</p> <p>79 cm (31.1")   8 Megapixels (colour)   17:9 Aspect ratio</p>	 <p><b>RX660 RadiForce</b></p> <p>The size and resolution of the monitor allow users to organize images as they see fit. The RX660 also take up less space than solutions with two 3-megapixel screens.</p> <p>76 cm (30")   6 Megapixels (colour)   16:10 Aspect ratio</p>	 <p><b>RX1270 RadiForce</b></p> <p>The compact and convenient all-rounder in radiological diagnostics for colour and monochrome images in virtually every size and resolution.</p> <p>78,4 cm (30.9")   12 Megapixels (colour)   3:2 Aspect ratio</p>	 <p><b>MX243W RadiForce</b></p> <p>The 24" colour monitor in widescreen format shows radiological images of specific tasks as well as images in pathology with the required precision.</p> <p>61 cm (24.1")   2.3 Megapixels (colour)   16:10 Aspect ratio</p>
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## Color

Given the absence of established color reproduction standards in pathology, at least consistent quality assessments assume vital importance. In this context, defined color standards such as sRGB should serve as orientation, and the monitors should be calibrated, considering the corresponding lighting conditions. You can achieve this goal by using self-calibrating monitors.



The most essential color spaces for image capture and image reproduction are sRGB, Adobe RGB, BT.2020, and DCI P3. Most products, such as monitors, printers, digital cameras, and various applications, are configured to reproduce the sRGB color gamut as accurately as possible. The color reproduction will differ if two devices use different color palettes (for example, a WSI scanner and a monitor).

## Calibration

Quality control and calibration of every monitor are essential, especially for pathology monitors throughout their service life. They contribute significantly to consistent and reliable diagnoses. In addition, the use of calibratable medical monitors guarantees compliance with future standards.

**Hardware calibration** involves adjustments in the monitor, covering parameters like brightness, white point, and gamma values. Any modifications are directly encoded into the monitor's Lookup-table (LUT) for meticulous calibration precision.

**Software calibration** requires adjustments in the monitor's graphics board. Consequently, the monitor must remain paired with the same computer to retain settings.

Hardware calibration boasts superior precision compared to software calibration.

The brightness of a monitor gradually decreases over time. Only regular quality checks and calibrations guarantee the consistent precision of the display and uniform image reproduction.





# Quality Control Software

Quality control software for medical monitors helps to perform tests according to national and international quality standards.

Server-based software solutions also enable centralized administration, which helps to manage the quality of all monitors in the network efficiently: All information

is brought together centrally, which also simplifies the creation of reports. Central management also helps to rectify problems where they occur.

In addition, future standards can be easily implemented, ensuring that they are applied to all monitors.







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# ARE YOU READY

## to elevate your Diagnostics?

Connect with our Smart In Media team today!  
Get the optimal monitor for diagnostic use,  
tailored for your medical excellence.

Improve your insight—pixel by pixel—and discover what  
else we can do to improve and accelerate your diagnostics.

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