White Paper

The Advantages of Medical LCD Monitors with LED Backlights

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1. Introduction

Images are displayed on an LCD monitor by controlling the output from the light source with liquid crystals. The light source is known as the backlight, and in the early days LCD monitors employed cold cathode fluorescent lamps (CCFL). Recently, light emitting diodes (LED) have evolved, and they are now being used as LCD monitor backlights. This paper will introduce the main advantages of medical image display monitors that utilize an LED backlight.

2. LEDs

2-1. What is an LED?

LEDs are said to be the fourth generation of light, following candles, light bulbs and fluorescent lamps. LED stands for “light emitting diode.” In other words, an LED is a semiconductor device that emits light when electric current is passed through it. The next section provides a simple explanation of how LEDs emit light.

Figure 1. LEDs (light emitting diodes)

2-2. The light emission principle of LEDs

The light emitter of an LED is constructed by joining two semiconductors, a P-type semiconductor and an N-type semiconductor, together. P-type semiconductors have an abundance of positively charged holes, while N-type semiconductors have an abundance of negatively charged electrons.

When an LED chip is subjected to voltage, the holes and electrons attract each other like the north and south poles of a magnet. As they attract each other, the holes and electrons collide and join together. When they join, the energy possessed by the holes and electrons becomes smaller. The extra energy is converted into light energy, and light is emitted. This is the light emission principle of LEDs.

In this way, the LEDs themselves emit light, and thanks to their superior characteristics, they have come to be used not only as room lights but also as backlights for LCD monitors.

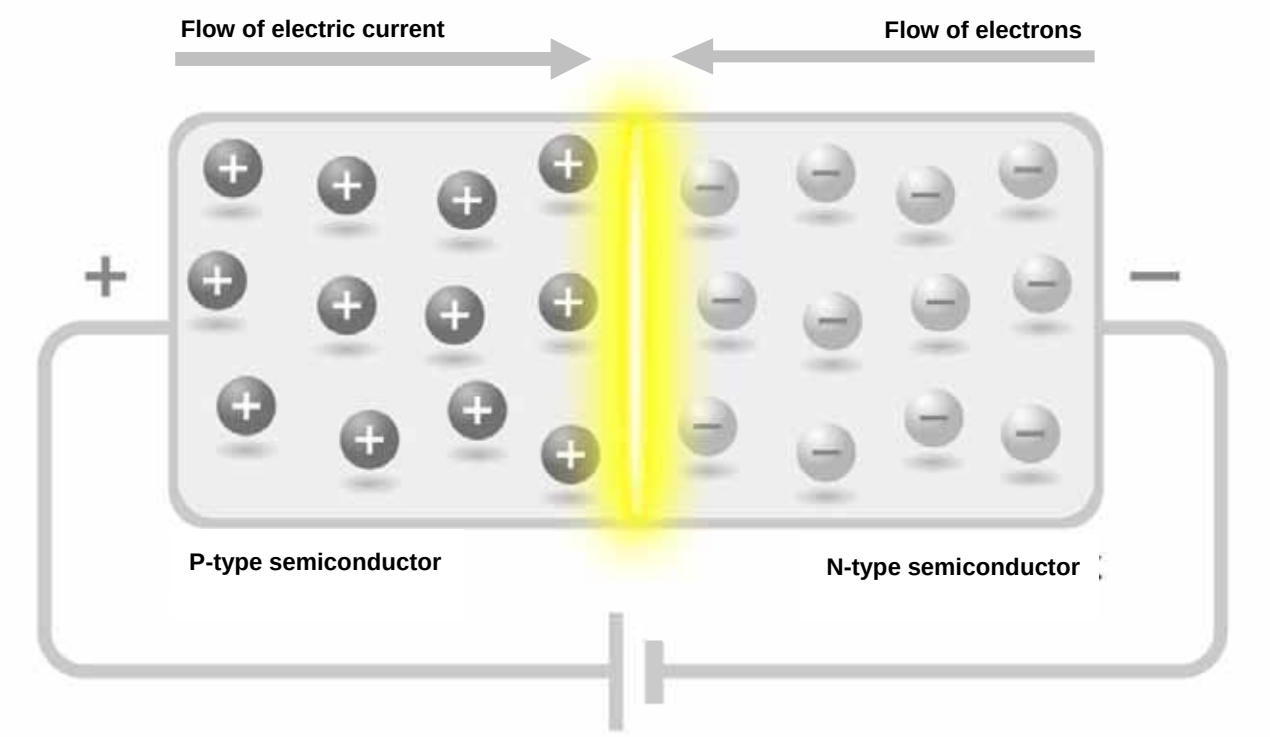


Figure 2. Light emission principle of LEDs

3. LED Backlights

3-1. What is an LED backlight?

The color of LED light, whether it is red, green, blue, etc., is not dependent on color filters or other such methods but is instead determined by the compounds comprising the semiconductor. What we will focus on here is white LEDs. The practical application of white LEDs has accelerated the application of LEDs in televisions, monitors and other display devices.

With LCD televisions and monitors, the LCD itself does not emit light, so a light source is required. Figure 3 shows the structure and many layers of an LCD monitor. The light source is positioned behind these layers, so it is called a backlight. Up until now, CCFLs had primarily been used as the light source, but in recent years LEDs are becoming more popular, and these are called LED backlights.

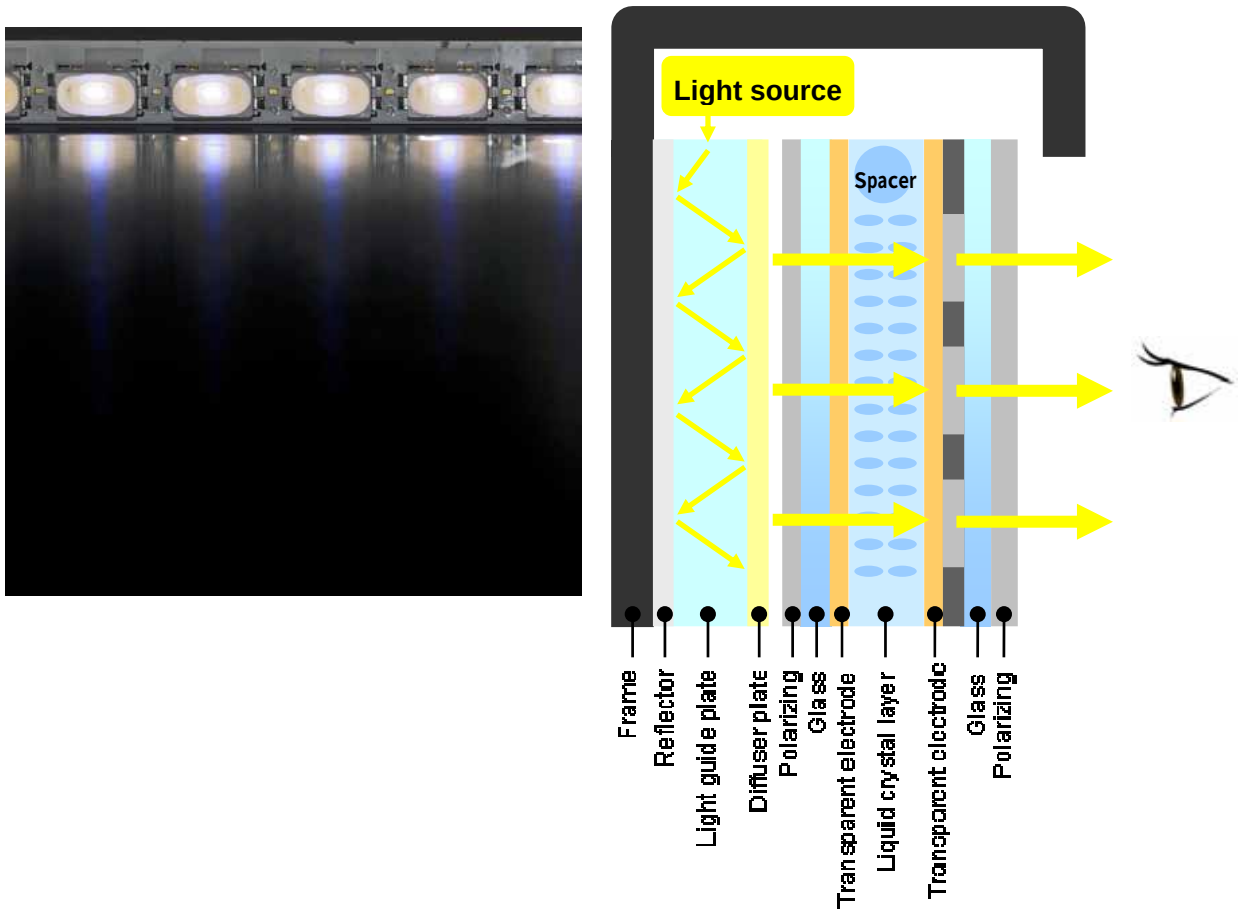
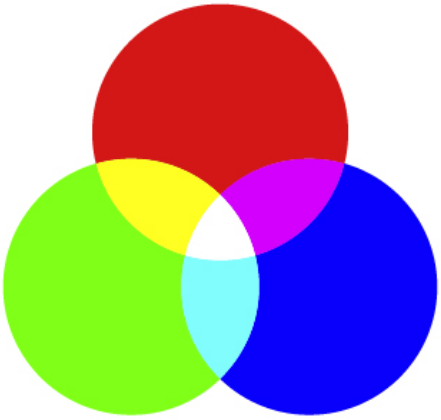


Figure 3. Structure of LCD monitors

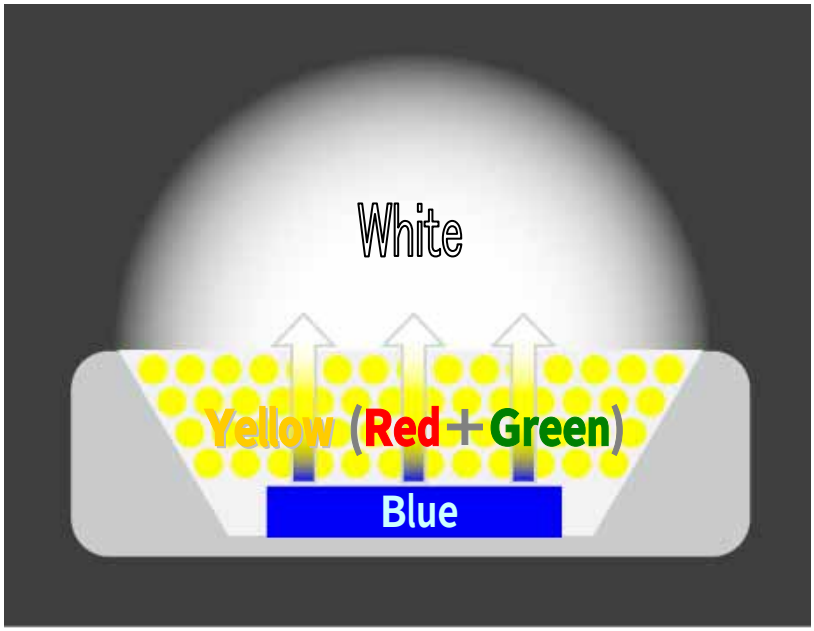
3-2. White LEDs

There are no LED chips that directly emit white light, so in order to produce white light using LEDs, two or more colors of light are mixed to produce white using what is known as the principle of additive color mixture.

The most common method is to combine a blue LED with a yellow phosphor. As shown in the figure, the blue light from the blue LED and the yellow light from the yellow phosphor mix to produce white light.



Additive color mixture



Blue LED + yellow phosphor

Figure 4. Additive color mixture and white LED

4. Characteristics of Monitors with LED Backlights

LEDs have many superior characteristics. There are three main advantages of using LEDs as the backlight in LCD monitors, namely longevity, low power consumption, reduction of environmental load.

4-1. Longevity

The main factor in the limited life span of the CCFL is the depletion of the inert gas and mercury enclosed in the glass tube. This is not the case with the LED.

Figure 5 is an example of variations in the brightness of a monitor with a CCFL backlight and one with an LED backlight during a 40,000 hour time-span. A clear difference is seen between the CCFL and LED. In the case of a monitor with a built-in brightness stabilizing circuit, the time-related changes in brightness that accompany backlight deterioration can be absorbed during a certain period of time, and this period is longer in the case of the LED. In the case of the backlights in Figure 5, when used continuously with a maximum brightness of 80% from hour 0, the CCFL can no longer maintain 80% after roughly 9,000 hours. However, the LED can do so for 24,000 hours.

The product life of the monitor is directly related to the longevity of its backlight. In other words, monitors that use LED backlights have longer life spans than those that use CCFL backlights. Thus, the user can use the monitor with peace of mind for a longer period of time.

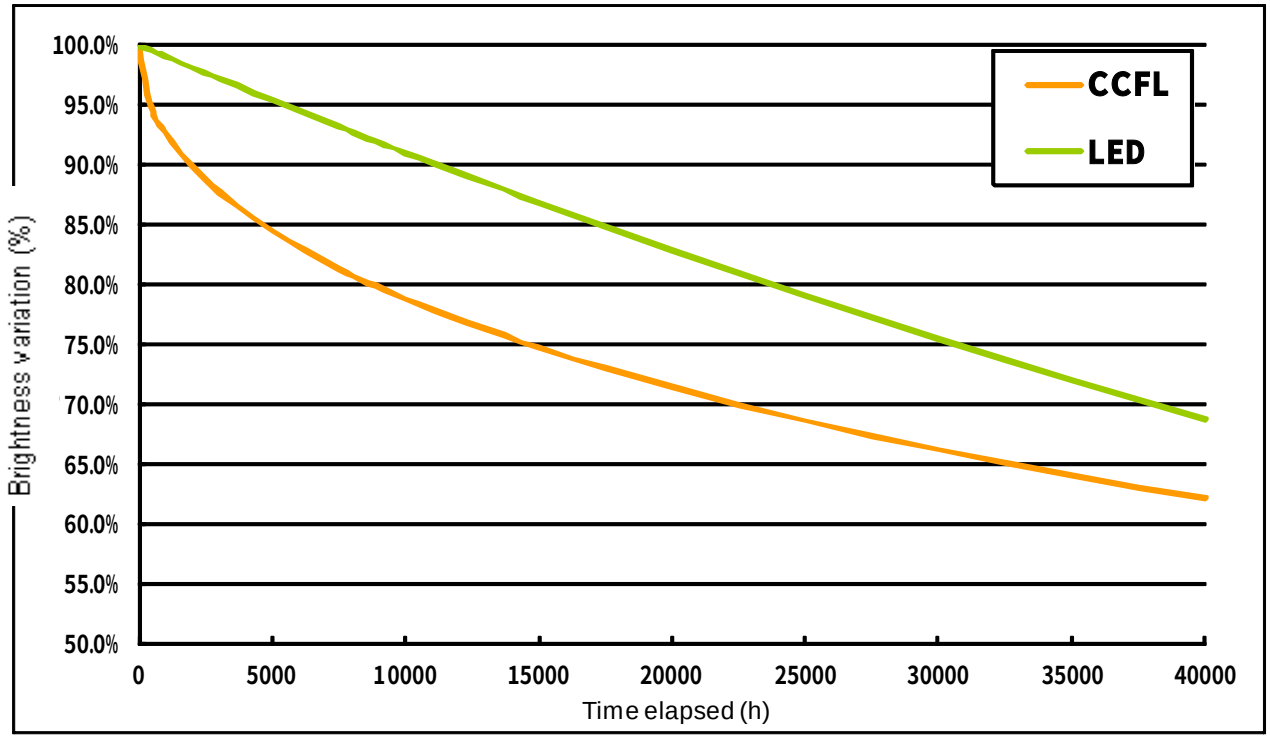


Figure 5. Example of variations in brightness over time

4-2. Low power consumption

A very large proportion of the monitor's overall power consumption is taken up by the backlight and its drive circuit. Although it depends on the model and its brightness settings, it is not unusual for the backlight and its drive circuit to use 80% or more of the total power consumed.

LEDs have a higher luminous efficiency than CCFLs, so when set to the same brightness, the power consumption of an LED backlight monitor is lower. Figure 6 shows the power consumption of a 5-megapixel monochrome monitor, a 3-megapixel monochrome monitor, a 2-megapixel monochrome monitor, a 4-megapixel color monitor, a 3-megapixel color monitor and a 2-megapixel color monitor which have been set at the recommended brightness.

Transmittance is lower for color than for monochrome, so the power consumption is higher when set to the same brightness. A comparison for each monitor between a CCFL or LED backlight in each case shows a reduction in power consumption of roughly 20%.

Much of the power consumed is converted into heat and escapes into the air. For this reason, when many monitors are installed, particularly in a small space, the temperature in the room rises markedly. The lower power consumption of the monitor not only lowers the portion of the electricity bill that comes from the monitor itself but also from the air conditioning as it helps control warming inside the hospital.

Based on the above, it can be said that LED backlight monitors contribute to the reduction of hospital energy bills. The effect of lower power consumption from a single monitor is not that big, but the effect on the energy bill will be greater the more monitors the hospital has.

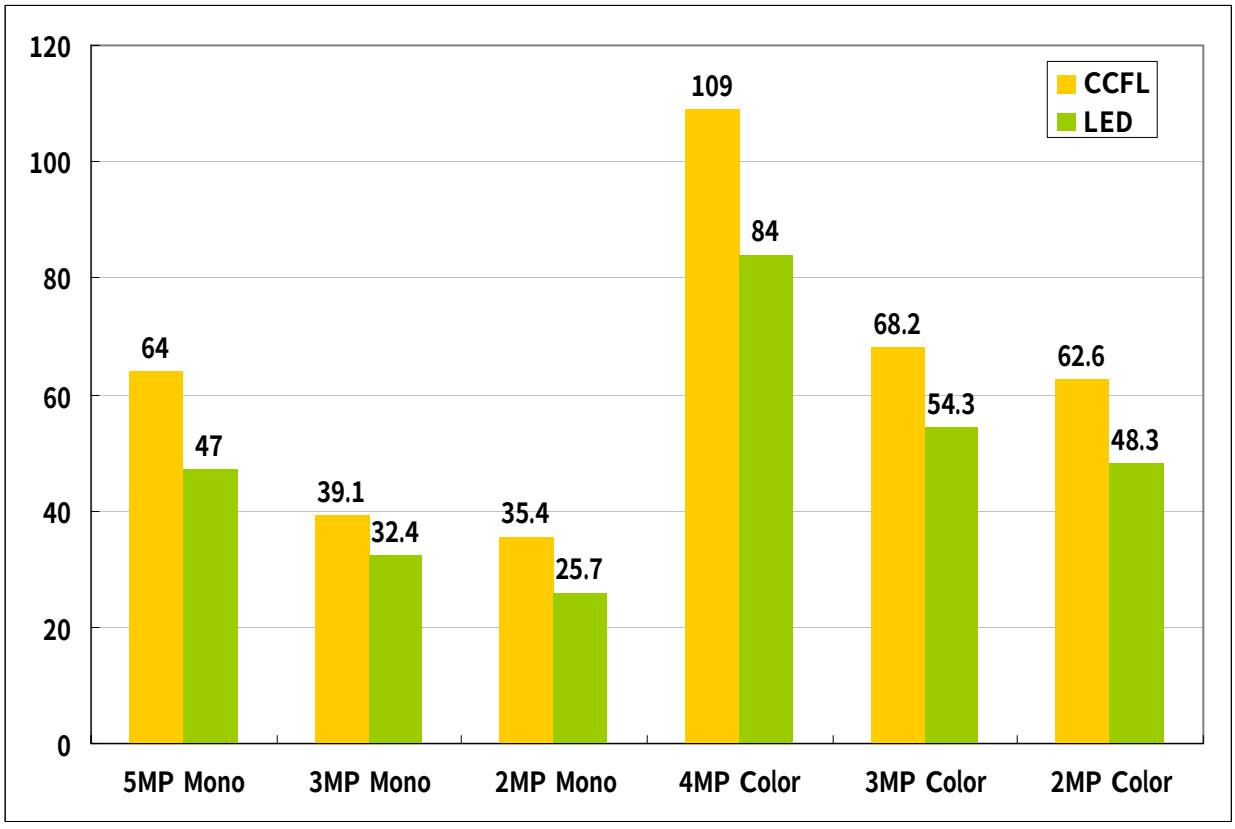


Figure 6. Comparison of power consumption (W) between CCFL and LED models

4-3. Reduced environmental load

CCFLs contain a small amount of mercury, so when disposing of CCFL backlight monitors, it must be handled according to the regulations of the country in question. Each country has its own controls in place as deemed appropriate. LEDs do not use mercury, so they can be called environmentally friendly devices. The direct advantage for the user is that when disposing of LED backlight monitors, there is no mercury to deal with.

5. Summary

Already widely used for lighting purposes, LEDs have become more popular as backlights for LCD monitors in recent years. Generally, white LEDs are used when the purpose is to act as a backlight.

LCD monitors with LED backlights have the following advantages compared to their counterparts with CCFL backlights:

- ✓ Longevity
- ✓ Low power consumption
- ✓ Reduced environmental load

We have a full lineup of medical monitors with LED backlights, from 2-megapixel monitors to 8-megapixel monitors, all of them offering longer life, lower power consumption and reduced environmental load.

RadiForce® LED