

LCD Backlights

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of trade-off between color gamut and power consumption. In general, we need more electrical power as the color gamut increases. In other words, wide color gamut CCFLs consume more power than the normal CCFLs do. Therefore, as the efficiency of LEDs increases, LEDs can have more advertisement columns emphasizing lower power consumption.

It can be considered as a very strong point of LED backlights that a high contrast ratio and lower power consumption can be achieved by local dimming technology. By considering an LED as a point light source, the local dimming of LEDs increases the contrast ratio dramatically, which CCFLs and FFLs can do only slightly. However, for the local dimming, LEDs have to receive video signals in advance and feedback the converted signals into the backlight unit. So there are several things to be carefully considered such as the complex circuitry, appropriate radiation pattern of light and additional components.

Since a large number of LEDs, each of which is considered as a point light source in the LCD backlights, need to spread light to have enough uniformity and color mixing, we need some additional considerations to overcome such as color mixing and color shifting. Color shifting is color variations from one LED to another depending on the grouping of LEDs, and also from temperature dependency of LEDs. A more difficult part is that the temperature dependencies of LEDs differ from the colors of LEDs. However, the biggest hurdle is the higher cost caused by low efficiency, resulting in large number of LEDs to have the required brightness. To achieve comparable cost, there should be various efforts and trials such as higher chip yield rate, better materials and structures, higher efficiency, advanced LED packaging techniques, removal of redundant components for thermal management and elimination of optical sheets.

1.4 Requirements/Specifications for LCD TV Backlights

Table 1.2 shows the general specifications for the backlights in LCD TVs.

1.4.1 Luminance

LCD TVs in general require brightness of 500 cd/m². Table 1.3 shows the brightness requirement for the backlight unit (BLU), assuming that the transmittance of the LCD panel is 3.5%. The brightness of a diffuser sheet and a reflective polarizer means that the brightness is measured at the top of the reflective polarizer. By considering polarization characteristics of the reflective polarizer, there is a gain of about two through its recycling when photons

Table 1.2 General specifications

Luminance (cd/m ²)
Color reproduction (% NTSC)
Correlated color temperature (K)
Life (hour)
Thermal management (max. °C)
Power consumption (W)

Table 1.3 Brightness of LCDTV (transmittance).

Brightness of BLU (cd/m ²)
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travel to the LCD panel. Due to example, from HD (1366×768) to by 15%. To compensate for the in Table 1.2 need to be increased tion of the full HD.

In the near future LCD TVs requirement can be met by improving and/or by increasing the brightness between cost and performance, backlight and the development process should be considered.

1.4.2 Color Reproducibility

1.4.2.1 Improvement of the

Recently, Sony and Kasei Opto CCFL color gamut from 72% to phosphor. Figure 1.6 shows its emission CCFLs. In the figure, the same phosphors, the main emission

Table 1.2 General specifications of LCD modules for TVs.

	Specification		Comments
	Year 2006	Year 2010	
Luminance (cd/m ²)	500	600	
Color reproduction (% NTSC)	72	100	
Correlated color temperature (K)	10000	13000	
Life (hour)	50000	75000	
Thermal management (max. °C)	50	40	
Power consumption (W)	150	70	40-inch

Table 1.3 Brightness of LCDTV backlights (requirement varies with panel transmittance).

	Diffuser sheet only	Diffuser sheet + DBEF
Brightness of BLU (cd/m ²)	14000	7000

travel to the LCD panel. Due to the increase in resolution of LCD TVs, for example, from HD (1366×768) to FHD (1920×1080), the aperture ratio drops by 15%. To compensate for the drop, the brightness requirements described in Table 1.2 need to be increased by an additional 15% to fulfill the specification of the full HD.

In the near future LCD TVs will require a brightness of 600cd/m². This requirement can be met by improving the transmittance of the LCD panel and/or by increasing the brightness of backlights. In either case, a trade-off between cost and performance, an optimization of the power budget of the backlight and the development of advanced optical sheets to increase brightness should be considered.

1.4.2 Color Reproducibility

1.4.2.1 Improvement of the Color Reproducibility of the CCFL

Recently, Sony and Kasei Optonics have reported the improvement of the CCFL color gamut from 72% to 92% by applying a newly codeveloped phosphor. Figure 1.6 shows its emission spectrum compared with that of normal CCFLs. In the figure, the same blue phosphor is used. In the spectrum of red phosphors, the main emission peak shows 5nm red-shift and the second

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