저온환경에서의 LED 평판 조명의 전기광학적 특성에 대한 연구

(Electric-optical Characteristics of LED Flat Light Source in Low Temperature Condition)

최대섭, 심용식, 정찬웅, 오선, 황종선, 한정민*

(Choi Dae Seub, Shim Yong Sik, Jung Chan Oong, Oh Seon, Hwang Jong Sun, Han Jeong Min)

Abstract

LCD (liquid crystal display) industry is needed to goods of high reliability and is interested in products without harmful material. In this experiment, we made the LED backlight unit for Automotive-navigation. And for making this backlight unit we used to eight side emitting type white LEDs with 1W high power of the lumileds company. We could know that this backlight unit releases to 6500 nit in 14W power consumption and start up voltage time is under the15ms in the ambient temperature -20 ℃

1. Introduction

According to the accelerative modern industry, the application fields of many display industries are various gradually. TFT(thin film transistor)-LCD field is continuously processed by means of the large size display from conventional monitor and note PC to TV industry. And TFT-LCD by the application field is applied as the mobile, PDA, and the camera. CNS (car navigation system) is appeared to the most requirements of customers. CNS product is gradually appeared to many needs in convenience of user interface, multimedia player and an intelligent car navigation system. Difference from properties of conventional TFT-LCD is that car navigation system is needed to high reliability in the wide operating temperature range, such as -20 to 50℃ vibration and an shock. And use of mercury is strictly restricted for driver security in the shut tight structure of car. We have to use backlight unit because liquid crystal display is non-emissive display of active type recently. Therefore CCFL of backlight unit of TFT-LCD is contented in mercury for generation of plasma discharge and starting up. It helps to discharge of CCFL in the normal temperature. But CCFL has defects in the lifetime characteristics of alteration to the liquid in the lower temperature and environmental problem [1-2]. So, guaranteed LED needed to operate in lower temperature, inside shock and vibration by backlight unit source of solid semiconductor is used for backlight source development of TFT-LCD in this experiment. And optical design is competed by considering to the characteristics of LED light source [3-4].

By using the eight side emitting type LEDs (each LED has 1 W high power), we achieved to the simplicity of mechanical structure and we know that the center brightness of this LED-BLU is 6500 nit by measurement.

2. Experomental and Results

In order to the development of TFT-LCD used by automobile navigation with needs of high reliability, we made LED BLU by using the side emitting type White LED with 1W high power of the lumileds company in this experiment. Figure1 is showing to the structure of side emitting type White LED with the consumption power of 1W and emitting characteristics of light.

Before manufacturing of LED Backlight Unit, we measured the light Flux of conventional TFT-LCD used by CCFL. The Result is 203lumen in 4W of the consumption power for the measurement of light intensity.

그림 1. 1와트급 측면출광방식 LED 패키지
Fig. 1. 1W side-emitter LED Package, (Lumileds, Co., Ltd)

In the base of result, the light Flux of 237 lumen is measured by used to eight side emitting type White LEDs of 1 W with emitting characteristics of 35 lm/W. Side-emitting LEDs

are particularly suitable for coupling the light from the LEDs directly into a light guide [5-8]. Figure 3 is showing to the structure of LED Backlight unit.

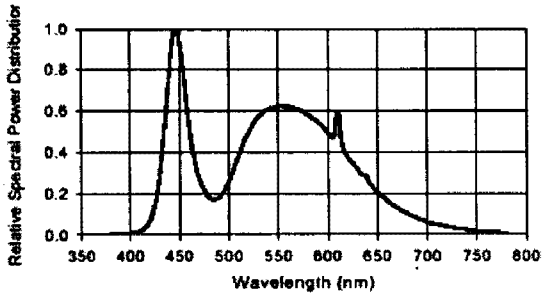

그림 2. 1W측면출광방식 LED의 스펙트럼 특성
Fig. 2. Spectrum data for 1W side-emitter type white LED

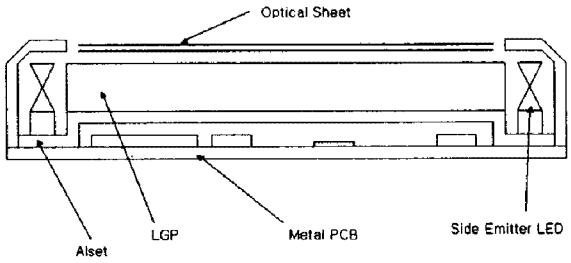

그림 3. LED 백라이트의 구조
Fig. 3. Structure of white LED backlight

Each four of Manufactured LED-BLU is arranged by light source at top and bottom. And generative emitting light by arranged light source has structure for incidence ray inside to the horizontal setting LGP. We used Prism sheet of 3M companyin order to improve the optical performance. In particular for properties maintenance of LCD with a light weight and small size, this BLU is designed in lower part of reflector generated by mount height of LED. And according to appliance for white LED, external form of LED-BLU is minimized without using each red, green, and blue LED.

The CCFL is mainly used by backlight unit of LCD at the present time. Because the brightness, lifetime and reaching time until the starting up voltage are changed by variation of the ambient temperature, the application of automobile navigation for needs of high reliability is unsuitable. Because of the problem of the operating characteristics and lifetime at the lower temperature, initial starting up voltage is particularly required to higher voltage value. The CCFL is contented in mercury, argon and neon gases in the vacuum. The very important gas of contents in lamp is mercury. Although the mercury is existed in the lamp, mercury is partly turnedto liquid according to decreasing of ambient temperature. Because of this phenomenon, starting discharge voltage for lamp starting up is required high voltage value at lower temperature. And brightness is decreased. Figure4 is showing to brightness characteristics graph of lamp.

The CCFL is required to High voltage at Initial starting up voltage. But LED backlight unit needs to lower starting up voltage of input voltage 3.42V. Also because of superior brightness characteristics in lower temperature, LED backlight unit is suitably applied to automobile navigation for needs of high reliability. Figure5 is showing to brightness characteristics of LED backlight unit according to change the temperature.

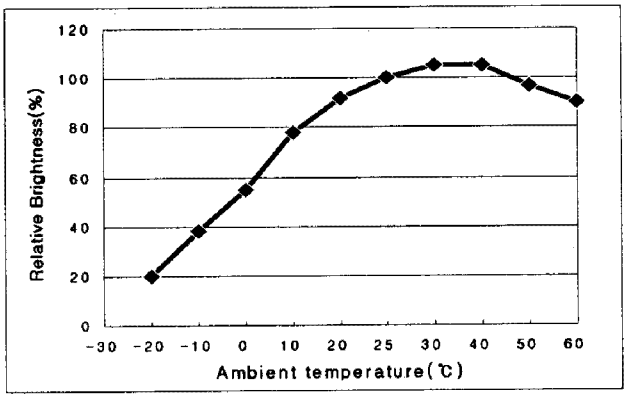

그림 4. 주변온도와 CCFL 백라이트의 휘도와의 관계
Fig. 4. Relative brightness of CCFL for ambient temperature

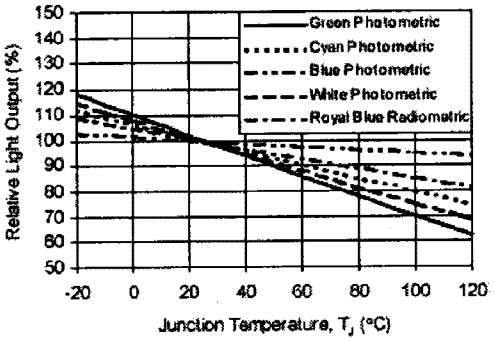

그림 5. 주변온도와 백색 LED의 휘도와의 관계
Fig. 5. Relative light output of white LED for ambient temperature

We compared normal backlight unit with conventional CCFL (Ne:Ar = 90%:10%, 80 torr) with manufactured LED-backlight for this experiment. We measured delay time of the starting up voltage according to the changing temperature with two backlight units. The normal BLU was operated by the Royer type inverter (HIU 741, Harison Co.,. Ltd) in condition that voltage 1100 Vrms.

The result of measurement occurred that no discharge phenomenon is 13 EA in 16 EA. Figure 6 is showing to a scheme of experimental setting for operating voltage measurement of backlight unit.

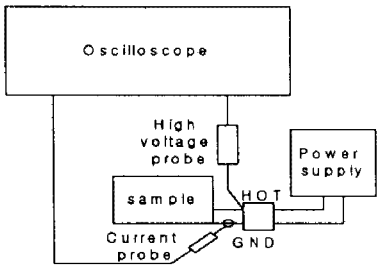

그림 6. 주변온도에 따른 점등지연시간을 측정하기 위한 시스템의 구성도

Fig. 6. Equipment of measure to delay time for BLU in the ampient temperature

Table 1 is showing condition of light source in the normal BLU and LED-BLU.

표 1. 일반 백라이트 및 LED 백라이트의 광원의 조건

Table 1. Condition of light source in the normal BLU and LED BLU

CCFL		White LED	
Dimension(L*D)	243±1.0*2.2 ±0.05	Dimension(L*H)	14.5±0.3*6.09
Starting up Voltage (Vrms,25℃)	1100	Forward Voltage (V)	3.4
Hg Amount (mg)	Typical 2.0	Forward Current (mA)	350
Electrode Material	Nikel	Optical efficiency (lm/W)	35
Electrode Length	6mm (cup type)	Radation type	side emitting
Pressure Ratio(Ne:Ar)	90 : 10	White color gernerate type	phosphor convert

Figure 7 is showing to the starting up voltage time of normal backlight unit used to CCFL and LED backlight unit in the normal temperature.

And, Figure 8 is showing to the starting up voltage time of normal backlight unit used to CCFL and LED backlight unit in the ambient temperature -20℃

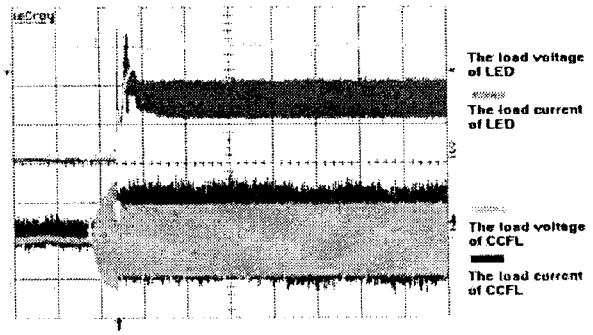

그림 7. 일반 백라이트 및 LED 백라이트의 일반온도 환경에서의 지연시간의 측정결과

Fig. 7. Delay time of normal BLU and LED BLU in the normal temperature.(25℃)

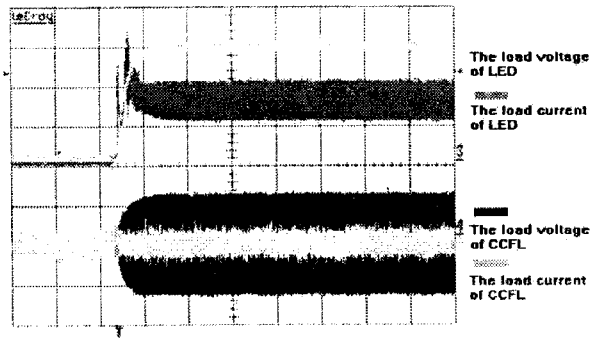

그림 8. 일반 백라이트 및 LED 백라이트의 저온도 환경에서의 지연시간의 측정결과

Fig. 8. Delay time of normal BLU and LED BLU in the low temperature.(-20℃)

3. Conclusion

Normal backlight unit with CCFL used to conventional backlight source of LCD occurs to the reliability problems at the lower temperature. To solve this problem, we release to the LED backlight unit. The LED backlight unit with eight side emitting type white LED of 1W appears to reach characteristics to the center brightness 6500 nit at total consumption power 13.3 W. As a result of this experiment result, we know that the reaching time to the starting up voltage value in backlight unit which used LED light source in the ambient temperature -20℃s under 15ms. And we confirmed that LED backlight source is solution for the starting up voltage characteristic improvement of CCFL with no discharge phenomenon in the lower temperature according to the result.

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