Light Emitting Diode

Balancing White Color

I. Preface

Light's three primary colors are red, green and blue.
Controlling these 3 colors' luminous intensity of LED can produce various colors.
This note explains how to reproduce white color with Nichia LED.

II. Color Reproduction

The triangle in Figure 1 shows the color reproduction range of color television and LED.
NTSC(National Television System Committee) is the video signal system(method) which is adopted in Japan, the United States, and Canada.
The wider the triangle becomes, the better color reproduction. As you see in Figure 1, color reproduction of LED is closer to the NTSC's than Color TV.

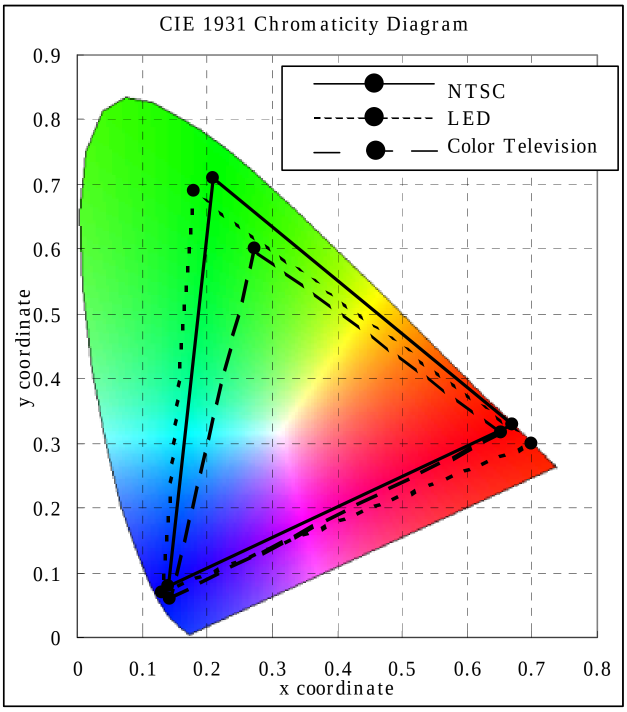

Figure 1

III. White Balance

Reproducing white without close control may become reddish white, bluish white and etc.
To produce the white color by LEDs, one must adjust the luminous intensity of blue, green and red. This adjustment is called "White balance."
In general, to produce white color (x=0.33 y=0.33), the luminous intensity ratio is R:G:B=3:7:1.
(It depends on the color coordinate of each Red, Green and Blue.)

IV. Balancing White Color of Full Color LED

i) Nichia's full color surface mount LED is composed of red, green, and blue elements in 1 package.
The following is an example of full color surface mount LED.

Item	Symbol	Condition	Blue			Green			Red			Unit
			Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
Forward Voltage	V_F	B,G I_F=10[mA] R I_F=20[mA]	-	3.6	4.0	-	3.5	4.0	-	1.9	2.4	A
Reverse Current	I_R	V_R=5V	-	-	50	-	-	50	-	-	50	μA
Luminous Intensity	Iv	B,G I_F=10[mA] R I_F=20[mA]	52	72	144	215	300	600	92	125	260	mcd

Figure 2 Initial Electricity / Optical Characteristic of NECM325C.

ii) Luminous Intensity

Suppose: The luminous intensity of Red: 125mcd.(Typical rating in Figure 2)

The luminous intensity of Green and Blue is derived from the ratio: R:G:B = 3:7:1

More specifically,Green=125 x 7/3 = 291.6[mcd]

Blue =125 x 1/3 = 41.6[mcd]

Therefore, to reproduce white color (x=0.33 y=0.33), the required luminous intensity is as follows respectively.

Red=125mcd Green=291mcd Blue=41mcd

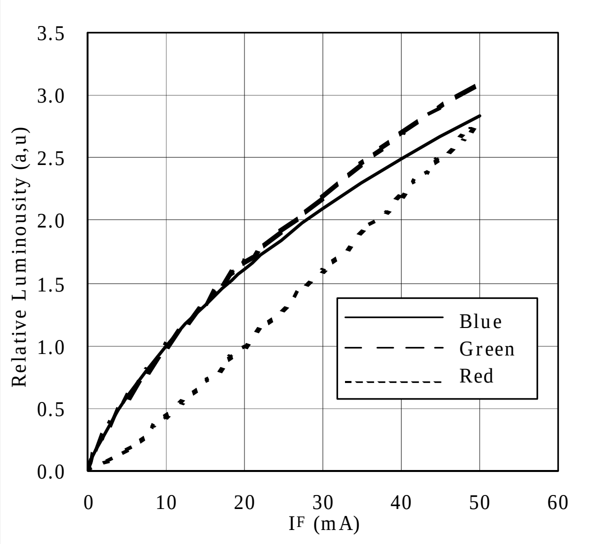

Figure 3

iii) Forward Current

Refer to Figure 2,

a)Red=125mcd The current value is 20mA.

b)Green

Suppose 300mcd is as 1.

291 / 300=0.97[times]

The forward current is about 9.8mA.(See Figure 3)

c)Blue

The same way of calculation result as 4.8mA

iv) Power Dissipation When you use full-color LED, total power dissipation must be within the absolute maximum rating.

Figure 4 shows "Ambient temperature" vs. "Power Dissipation" of NECM325C.

Power Dissipation is derived as follows.

P_D[mW]=I_F[mW] x V_F

Power Dissipation for ii) and iii)

P_D[mW]=20[mA]x1.9[v]+9.8[mA]x3.5[v]+4.8[mA]x3.6[v]

=89.58[mW]

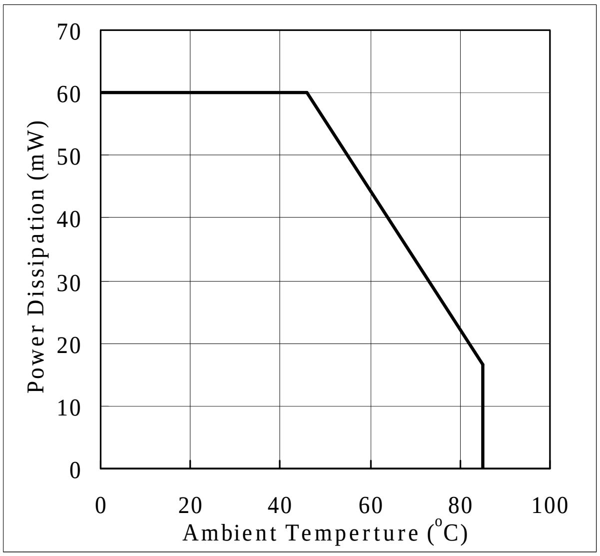

Figure 4

And 89.5mW exceeds absolute maximum rating in Figure 4.

You must lower the forward current of each die.

Luminous intensity of Red : 60mcd,

Calculating required luminous intensity of blue and green.

Derived form (Refer to ii).

Green = 140mcd

Blue = 20mcd

The approximate current values are derived form Figure 3 at the above luminous intensity.

Red=11mA Green=3.5mA Blue=1.8mA

P_D[mW]=11[mA] x 1.9[v]+3.5[mA] x 3.5[v]+1.8[mA] x 3.6[v]=39.63[mW]

Total power dissipation of 39.63mW should be operated within 65 °C from Figure 4.

It is important that the total power dissipation must be within the absolute maximum rating.