

Improved structure of back light

Field of the invention

The present invention relates to an improved structure of back light, by which the brightness and uniformity of luminance can be enhanced.

5 Background of the invention

The conventional back light has the problem of nonuniform luminance. In other words, the luminance is weaker at the light guide portion far off the light source, in comparison with the guide portion near the light source.

Fig. 9 and 10 show the perspective view and exploded view of conventional
10 COB (chip on board) type back light. The conventional COB type back light generally comprises a PC board 1, a reflective cover 2, and a diffusion plate 3. The PC board 1 is arranged below the reflective cover 2 and has a plurality of light emitting diodes (LEDs) as light source. The diffusion plate 3 is placed
15 upon the reflective cover 2, and epoxy is filled there between. The employment of diffusion plate 3 can enhance the brightness of the back light. However, the cost of diffusion plate is high, and performance thereof is not quite satisfactory.

The improved structure of back light in basic application has provided a grating structure over the surface of light guide, therefore, the light emitting from the LED provided on bottom side or lateral side of the light guide and
20 traveling within the light guide can be reflected or refracted by the grating structure and concentrated to front side. Accordingly, the viewable angle can be decreased while the brightness within the viewable angle is uniformly enhanced.

The object of the present invention is to provide a further improvement over
25 the back light structure proposed in basic application. The pitch of the grating structure over the surface of light guide is not constant but changed gradually such that the luminance far off the light source can be enhanced. Therefore, the

luminance can be made uniform. Moreover, the back surface of light guide is carved and bossed to enhance the brightness of back light.

The improved structure of back light according to the present invention comprises a light guide, a plurality of LEDs arranged on the bottom or lateral
5 side of the light guide and a grating structure over the surface of the light guide.

The two-dimensional grating structure has variable pitch, the grating structure is denser on the light guide portion far off the light source, and is sparser on the portion near the light source.

The various objects and advantages of the present invention will be more
10 readily understood from the following detailed description when read in conjunction with the appended drawings, in which:

Brief description of drawings:

Fig. 1 shows the perspective view of the first embodiment according to present invention;

15 Fig. 2 shows the cross section view of the light guide shown in Fig.1;

Fig. 3 shows the perspective view of the second embodiment according to present invention;

Fig. 4 shows the perspective view of the third embodiment according to present invention;

20 Fig. 5 shows the perspective view of the fourth embodiment according to present invention;

Fig. 6 shows the perspective view of the fifth embodiment according to present invention;

25 Fig. 7 shows the perspective view of the sixth embodiment according to present invention;

Fig. 8 shows the exploded view of the sixth embodiment according to

present invention;

Fig. 9 shows the perspective view of conventional COB (chip on board) type back light; and

Fig. 10 shows the exploded view of conventional COB (chip on board) type back light.

Numeral

1 PC board

2 reflective cover

3 diffusion tape

10 21 light guide

23 LED

25 grating structure

31 PC board

32 reflective cover

15 35 grating structure

Detailed description of the preferred embodiment.

Fig.1 shows the perspective view of the first embodiment according to present invention. The improved back light according to the present invention comprises a light guide 21 and a plurality of LEDs 23.

20 The light guide 21 is placed to stage of PCB which is mounted a plurality of LEDs 23 as light source. One-dimensional grating structures 25 are provided on front and back surface of the light guide 21 to form grating surface thereon. Finally, the LEDs 23 are arranged on the bottom side of the light guide 21 to

form a LED back light.

After the arrangement of the LEDs 23, a silicone layer is coated over the surface of the LEDs 23 such that the light emitting from the LEDs can be transmitted into the light guide 21 directly.

5 In the improved structure of back light according to the present invention, the grating structure 25 is formed simultaneously with the light guide 21 during the mold injection process. By the grating structure 25, the viewable can be advantageously decreased while the luminance within the viewable angle can be uniformly enhanced.

10 The pitch of grating structure 25 over the surface of the light guide 21 is not constant but changed. The grating structure 25 is denser on the portion of light guide 21 far off the LEDs 22 and is sparser on the portion near the LEDs 22. By this arrangement, the luminance can be enhanced uniformly. Moreover, the back surface of light guide can be rough to enhance the effect.

15 Fig.2 shows the cross section view of the light guide 21 shown in Fig.1. With the improved structure, light can radiate uniformly form the grating surface. By the grating structure 25, the viewable can be advantageously decreased while the luminance within the viewable angle can be uniformly enhanced.

20 The angle of the grating structure 25 arranged on the light guide 21 depends on the view angle of front side and the viewable angle of LCD. The viewable angle of LCD is generally not large, therefore, the grating structure can advantageously concentrate the light within a smaller angle on front side.

25 Fig. 3 shows the perspective view of the second embodiment according to present invention. The improved back light according to the present invention comprises a light guide 21 and a plurality of LEDs 23. The circuit board is placed below light guide 21. A plurality of LEDs 23 are provided on the circuit board as light source. Two-dimensional grating structures 25 are provided on front and back surface of the light guide 21 to form grating surface thereon.

Finally, the LEDs 23 are arranged on the bottom side of the light guide 21 to form a LED back light.

The pitch of grating structure 25 over the surface of the light guide 21 is not constant but changed. The grating structure 25 is denser on the portion of light guide 21 far off the LEDs 22 and is sparser on the portion near the LEDs 22. By this arrangement, the luminance can be enhanced uniformly. Moreover, the back surface of light guide can be carved or grounded to enhance the effect.

Fig4 and Fig5 shows the perspective views of the third and forth embodiment of the present invention. One- or two-dimensional grating structures arranged in diagonal fashion are provided on the surface of light guide 21, respectively.

The pitch of grating structure 25 over the surface of the light guide 21 is not constant but changed. The grating structure 25 is denser on the portion of light guide 21 far off the LEDs 22 and is sparser on the portion near the LEDs 22. By this arrangement, the luminance can be enhanced uniformly. Moreover, the back surface of light guide can be carved or grounded to enhance the effect.

Fig. 6 shows the perspective view of the fifth embodiment according to present invention. The improved back light according to the present invention comprises a light guide 21 and a plurality of LEDs 23. One-dimensional grating structures 25 are provided on front and back surface of the light guide 21 to form grating surface thereon.

The pitch of grating structure 25 over the surface of the light guide 21 is not constant but changed. The grating structure 25 is denser on the central portion between LEDs 22 and is sparser on the portion near the LEDs 22. By this arrangement, the luminance can be enhanced uniformly. Moreover, the back surface of light guide can be carved or grounded to enhance the effect.

Fig.7 and 8 show the perspective and exploded view of the sixth embodiment of the present invention. The COB type back light of the sixth embodiment

comprises a PC board 31 and a reflective cover 32. A plurality of LEDs are arranged on the PC board 31, and the transparent or milk-color reflective cover 32 are arranged thereon. One- or two-dimensional grating structure are arranged in the surface of the reflective cover 32 to form grating surface thereon.

- 5 The pitch of grating structure 35 over the surface of the reflective cover 32 is not constant but changed. The grating structure 35 is denser on the portion of the reflective cover 32 far off the LEDs and is sparser on the portion near the LEDs. By this arrangement, the luminance can be enhanced uniformly. Moreover, the back surface of light guide can be carved or grounded to enhance
10 the effect.

- In the above back light, the light emitted from light source can be guided, by the grating structure 35 over the surface of the reflective cover 32, uniformly to the light-emitting surface. The brightness of COB-type back light can be increased about 20%. Moreover, the cost is reduced about 30% because an
15 expensive diffusion tape is not necessary and the processing of filling gel can be omitted. The grating structure 35 can be formed simultaneously with the reflective cover 32 during the injection molding process; therefore, the process is simple.

- The two-dimensional grating structure has better ability to guide the light
20 propagating within light guide to the emitting surface, in comparison with the one-dimensional grating structure. In other words, the two-dimensional grating structure has better ability to guide the emitting light within the viewable angle of the LCD with enhanced luminance, in comparison with the one-dimensional grating structure.

- 25 In the back light provided by the present utility, the requirement on the grade and number of LED chip lessened. Moreover, an expensive diffusion tape is not necessary, while the luminance can be enhanced uniformly.

In the improved structure of back light according to the present invention, one- or two-dimensional grating structures are formed on the front

side and back side of the light guide (or reflective cover). Moreover, the grating structure is formed simultaneously with the light guide (or reflective cover) during the mold injection process, and no further process is needed.

5 The pitch of grating structure over the surface of the light guide (or reflective cover) is not constant but changed. The grating structure is denser on the portion far off the LEDs and is sparser on the portion near the LEDs. By this arrangement, the luminance can be enhanced uniformly. Moreover, the back surface of light guide can be carved or grounded to enhance the effect.

10 Although the present invention has been described with reference to the two preferred embodiments thereof, it will be understood that the invention is not limited to the details thereof. Various substitutions and modifications have suggested in the foregoing description, and other will occur to those of ordinary skill in the art. Therefore, all such substitutions and modifications are intended to be embraced within the scope of the invention as defined in the appended
15 claims.

**Claims:**

1. An improved structure of back light comprising a light guide, a plurality of LEDs arranged on the bottom side of the light guide and a one-dimensional grating structure over the surface of the light guide, and characterized in that:
 - 5 said grating structure has variable pitch, the grating structure being denser on the light guide portion far off said LEDs, and being sparser on the portion near said LEDs.
2. The improved structure of back light as in claim 1, wherein the back surface of said light guide can be carved or grounded to enhance the effect.
- 10 3. An improved structure of back light comprising a light guide, a plurality of LEDs arranged on the bottom side of the light guide and a two-dimensional grating structure over the surface of the light guide, and characterized in that:
 - said grating structure has variable pitch, the grating structure being denser on the light guide portion far off said LEDs, and being sparser on the portion near
 - 15 said LEDs.
4. The improved structure of back light as in claim 3, wherein the back surface of said light guide can be carved or grounded to enhance the effect.
5. An improved structure of back light comprising a light guide, a plurality of LEDs arranged on the lateral side of the light guide and a one-dimensional
- 20 grating structure over the surface of the light guide, and characterized in that:
 - said grating structure has variable pitch, the grating structure being denser on the light guide portion far off said LEDs, and being sparser on the portion near said LEDs.
6. The improved structure of back light as in claim 5, wherein the back surface
- 25 of said light guide can be carved or grounded to enhance the effect.
7. An improved structure of back light comprising a light guide, a plurality of



LEDs arranged on the lateral side of the light guide and a two-dimensional grating structure over the surface of the light guide, and characterized in that:

said grating structure has variable pitch, the grating structure being denser on the light guide portion far off said LEDs, and being sparser on the portion near
5 said LEDs.

8. The improved structure of back light as in claim 7, wherein the back surface of said light guide can be carved or grounded to enhance the effect.

9. An improved structure of back light comprising a reflective cover, a plurality of LEDs arranged on the bottom side of the reflective cover and a one-
10 dimensional grating structure over the surface of the light guide, and characterized in that said grating structure has constant pitch.

10. The improved structure of back light as in claim 9, wherein the back surface of said reflective cover can be carved or grounded to enhance the effect.

15 11. An improved structure of back light comprising a reflective cover, a plurality of LEDs arranged on the bottom side of the reflective cover and a two-dimensional grating structure over the surface of the light guide, and characterized in that said grating structure has constant pitch.

20 12. The improved structure of back light as in claim 11, wherein the back surface of said reflective cover can be carved or grounded to enhance the effect.

25 13. An improved structure of back light comprising a reflective cover, a plurality of LEDs arranged on the bottom side of the reflective cover and a one-dimensional grating structure over the surface of the light guide, and characterized in that

said grating structure has variable pitch, the grating structure being denser on the light guide portion far off said LEDs, and being sparser on the portion near



said LEDs.

14. The improved structure of back light as in claim 13, wherein the back surface of said reflective cover can be carved or grounded to enhance the effect.
- 5 15. An improved structure of back light comprising a reflective cover, a plurality of LEDs arranged on the bottom side of the reflective cover and a two-dimensional grating structure over the surface of the light guide, and characterized in that
- 10 said grating structure has variable pitch, the grating structure being denser on the light guide portion far off said LEDs, and being sparser on the portion near said LEDs.
16. The improved structure of back light as in claim 15, wherein the back surface of said reflective cover can be carved or grounded to enhance the effect.