HIKVISION

WHITE PAPER

Hikvision Advanced Infrared Technology

EXIR 2.0

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EXIR 2.0

1. Background

In surveillance industry, with the growing popularity of the all-weather monitoring, the requirement of IR LED is getting higher and higher. And the brightness, reliability as well as lifespan become vital indexes for camera's quality. Initially, DIP IR LEDs with diameter of 3 mm, 5 mm, 8 mm were wildly used by camera manufacturers. However, Hikvision, as forerunner of the infrared camera, took the lead in developing EXIR camera a few years ago. With the boost of market demand and continuous technical progress, based on EXIR 1.0, Hikvision officially launched the new generation infrared technology, EXIR 2.0.

As the extension and expansion of EXIR 1.0, EXIR 2.0 not only inherits EXIR 1.0's advantages including thin-film light emitting, high luminous efficiency, low thermal resistance and long lifespan, but also makes new breakthroughs as well as huge advantages compared with EXIR 1.0 and DIP IR. Now let's in turn introduce EXIR 2.0's advantages and features compared to EXIR 1.0 and DIP IR.

2. Advantages(compared to EXIR 1.0)

2.1 No need for secondary optical lens

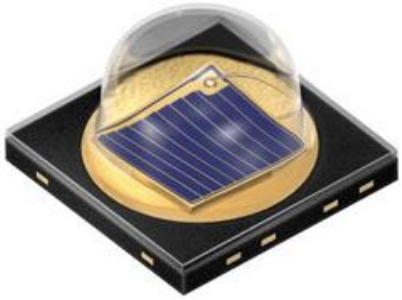

Figure 1: EXIR 2.0

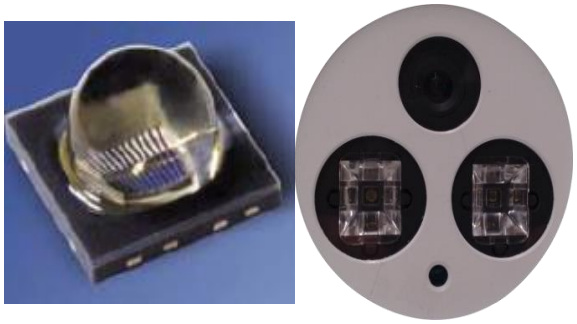

Figure 2: EXIR 1.0

EXIR 1.0's emitting angle is 90 °. To match camera with narrow angle of view (such as 30 °), it requires a secondary lens. Secondary lens focuses the infrared light so that IR LED's emitting angle can match up with the camera's angle of view. Figure 3 shows the light intensity distribution of EXIR 1.0 with secondary lens (90 °)

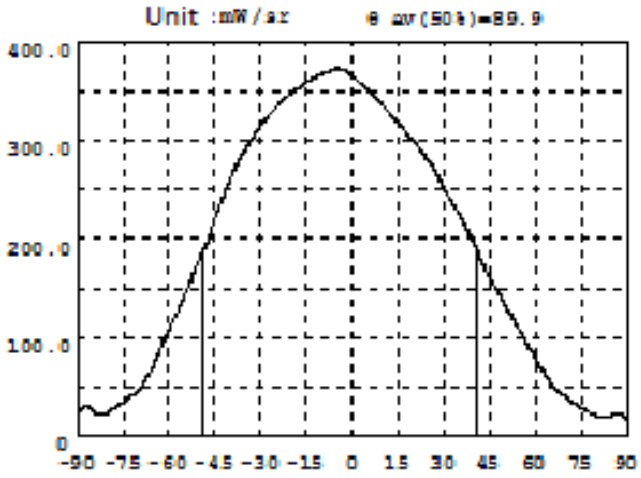

Figure 3. The light intensity distribution of EXIR 1.0 with secondary lens (90 °)

EXIR 2.0 doesn't need a secondary lens and according to the optical principle, it focuses the infrared light by its own small optical lens, making the IR LED's emitting angle match up with the camera's angle of view. Figure 4 shows the light intensity distribution of EXIR 2.0 with its own small lens (22 °)

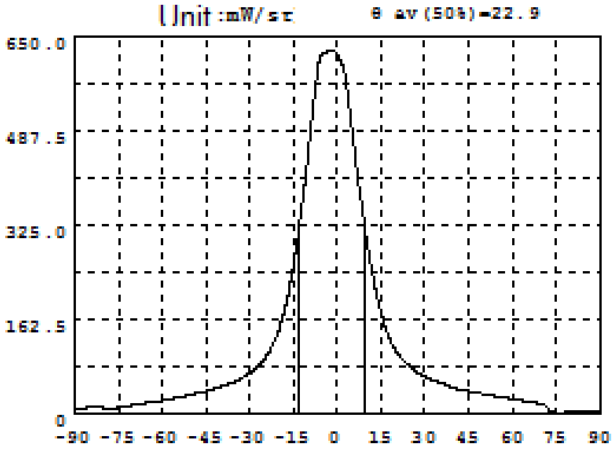

Figure 4. The light intensity distribution of EXIR 2.0 with its own small lens (22 °)

2.2 Lower optical loss, higher IR utilization

Because of the secondary lens, the IR light reflects on the incident plane and exit plane, and the material also absorbs the light, which results in about 10%~30% decrease of IR utilization. Figure 5 shows the reflection on the incident plane and exit plane.

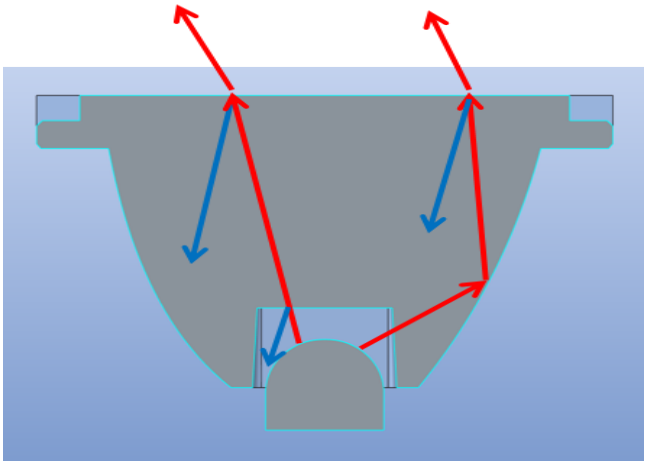

Figure 5. The reflection on the incident plane and exit plane.

2.3 Better heat dissipation

EXIR 2.0 adopts eutectic die attachment technology, figure 6, in which chip and substrate are fixed by mental solder, AuSn20. Eutectic die attachment enables higher pyroconductivity, small thermal resistance (about 3-5°C/W) and better heat dissipation. While EXIR 1.0 adopts silver gel die attachment technology, figure 7, which is of lower pyroconductivity, bigger thermal resistance (about 8-12°C/W) and poorer heat dissipation.

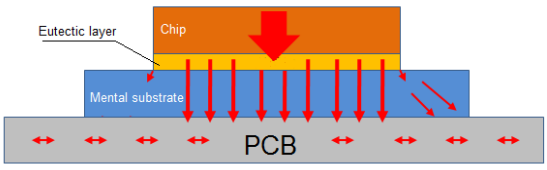

Figure 6. Eutectic die attachment

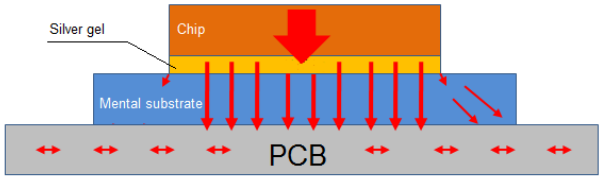

Figure 7. Silver gel die attachment

2.4 Longer lifespan

Under the condition of the same heat dissipation, EXIR 2.0 enables longer lifespan because of its better heat dissipation performance. For EXIR1.0, its lifespan is about 20000-30000 hours, while for EXIR 2.0, it's about 30000-40000 hours.

2.5 Product's miniaturization

The size of EXIR 1.0's secondary lens is large and usually its diameter is over 15mm, which greatly limits the product's miniaturization. While for EXIR 2.0, there is no need for the secondary lens, so the smaller

application is available.

2.6 Suitable for near-to-mid-range infrared monitoring

Benefit from the improvement of software and hardware, EXIR 2.0 provides better infrared effect for near-to-mid-range cameras (infrared distance within 80m, focus with 25mm), better meeting the needs of the near-to-mid-range market.

2.7 Easier production

For EXIR 1.0, the secondary lens needs to be fixed on the aluminum substrate manually, which wastes labor and time. While for EXIR 2.0, the secondary lens is no longer required, so labor and time cost will be greatly saved.

3. Advantages(compared to EXIR 1.0)

Except the advantages above, EXIR 2.0 is of more remarkable strengths compared to DIP IR LED.

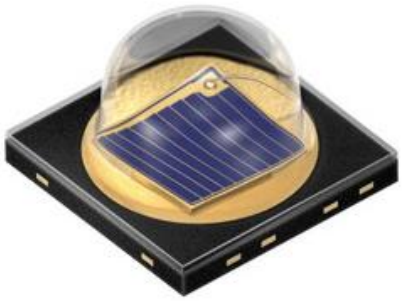

Figure 9. EXIR2.0

Figure 10. DIP IR LED

3.1 Better weather resistance and temperature resistance

The main ingredient of DIP LED's sealing glue is epoxy resin. While for EXIR 2.0, it is silica gel which enables better weather resistance and temperature resistance.

Figure 11 shows the discoloration of epox resin and silica gel under UV light after 168 hours

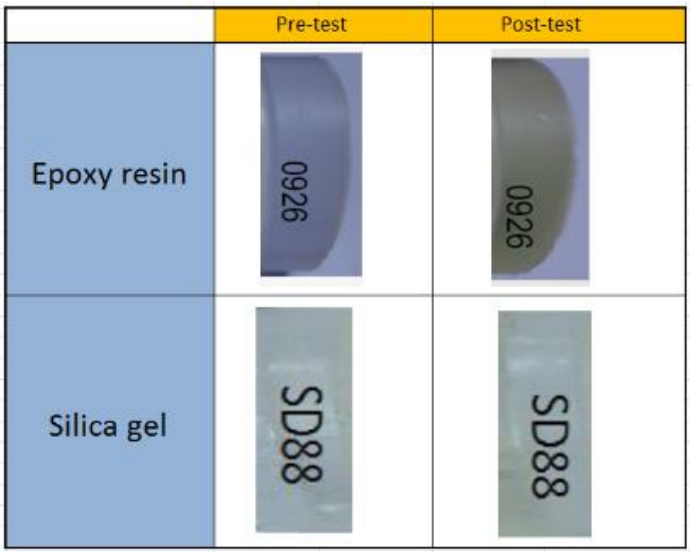

Figure 11. Discoloration of epoxy resin and silica gel

From the picture we can see that the discoloration of epoxy resin is very obvious.

Figure 12 shows the aging of epoxy resin and silica gel under 150°C after 72 hours

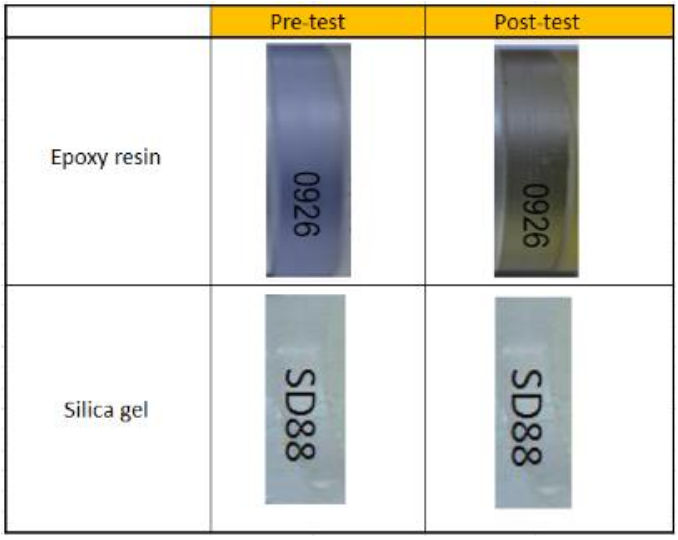

Figure 12. Aging of epoxy resin and silica gel

From the picture we can see serious discoloration of epoxy resin.

3.2 Better production process

DIP LED adopts plain mold gluing encapsulation which can't ensure uniformity. Because of epoxy resin's poor temperature resistance, unable to withstand temperature of 200℃, the room temperature solder paste is unusable. So the infrared lamp and other electronic devices on substrate need to be soldered twice by

solder paste with different temperatures which causes increase of product process and decrease of reliability and performance. However, EXIR 2.0 adopts automatic molding process, all the electronic devices soldered at one time, which greatly improves the product reliability.

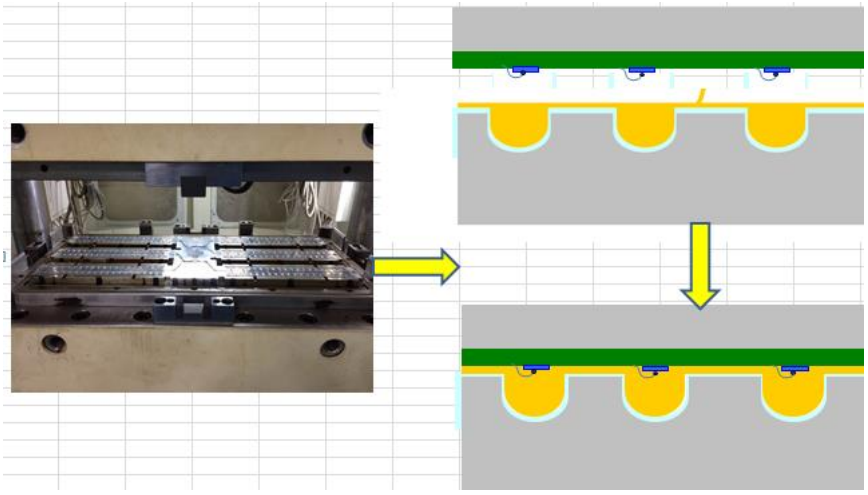

Figure 13 EXIR 2.0, precise die mold + silica gel compression molding process

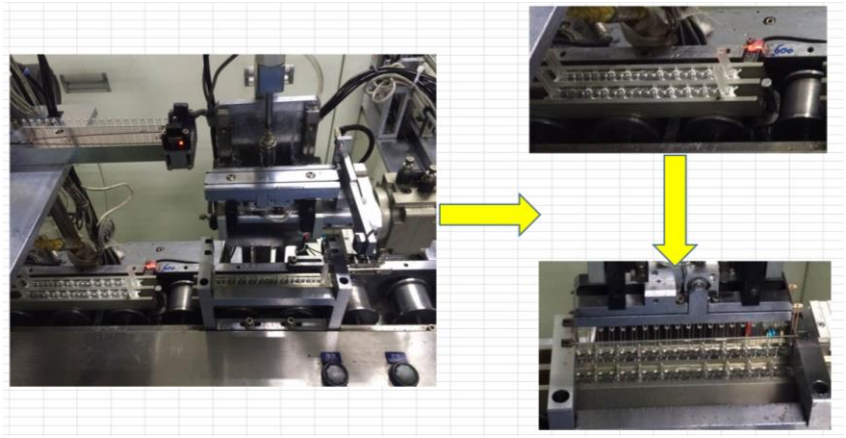

Figure 14. DIP IR LED, plain mode article + gluing process

3.3 Better LED epitaxial chip material and more advanced technology

1) DIP LED adopts ternary LED chips including GaALAs and GaAsP, while EXIR uses quarternary LED chips, InGaALP. The quarternary LED chips can increase the recombination rate of the carrier and the hole, improving the luminous efficacy.

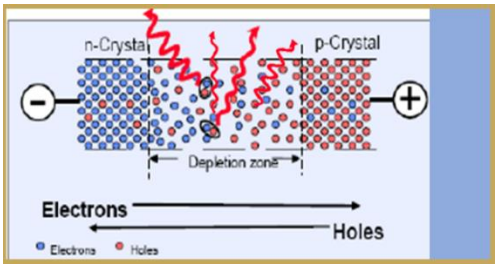

Figure 15. Quarternary chip

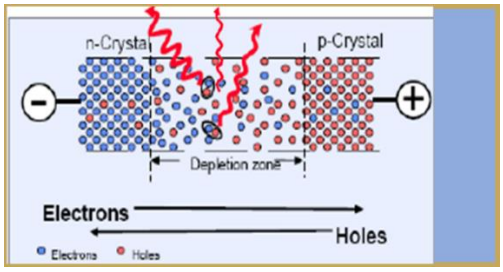

Figure 16. Ternary chip

2) DIP LED's chip adopts vapor phase epitaxial (VPE) growth method. By chemical vapor deposition, namely in the gas phase state, the semiconductor material is deposited on single crystal wafer to get the light emitting chip. This method requires high growth temperature and long production time. While EXIR 2.0's chip adopts metalorganic chemical vapor deposition (MOCVD), also known as Metalorganic vapor phase epitaxy (MOVPE) or organometallic vapor phase epitaxy (OMVPE), a new production method developed on the basis of VPE. This method requires low growth temperature suitable for the mass production of ultra-thin wafers. Meanwhile, the wafers are of high purity and good evenness.

3) DIP LED's chip adopts body emitting technology. The whole chip emits by heating. Consequently, a lot of light is absorbed after internal reflection and the light utilization is low. While EXIR 2.0 adopts surface emitting technology.

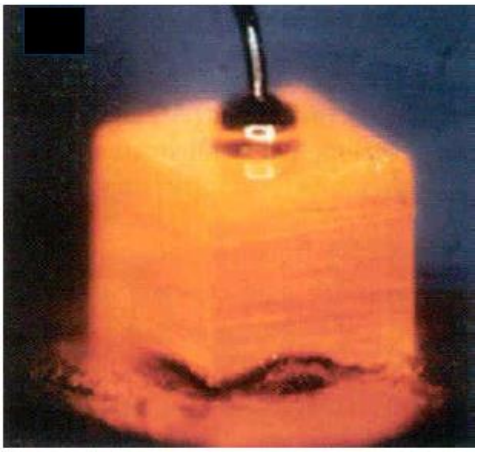

Figure 17. Body emitting

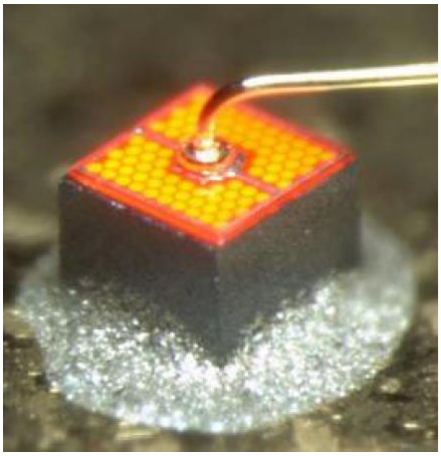

Figure 18. Surface emitting

3.4 Higher luminous efficiency

Luminous efficacy, which means total luminous flux under nominal power consumption, is a vital factor for chips. Higher luminous efficacy, more environment friendly. The maximum luminous efficacy of EXIR 2.0 is 45% under 0.45A current. While for DIP LED, it's 35%.

3.5 Up to 350mW luminous power

Luminous power which refers to the optical radiation power under nominal power consumption is an important parameter to evaluate LED chips. Larger luminous power means higher brightness. The luminous power of EXIR 2.0 LED is about 350mW. And for DIP LED, it's about 25mW. Thus, one EXIR 2.0 LED's brightness is equal to that of 14-16 DIP IR LEDs.

Figure 18 shows the luminous power comparison between 2 EXIR 2.0 LEDs and 24 DIP IR LEDs

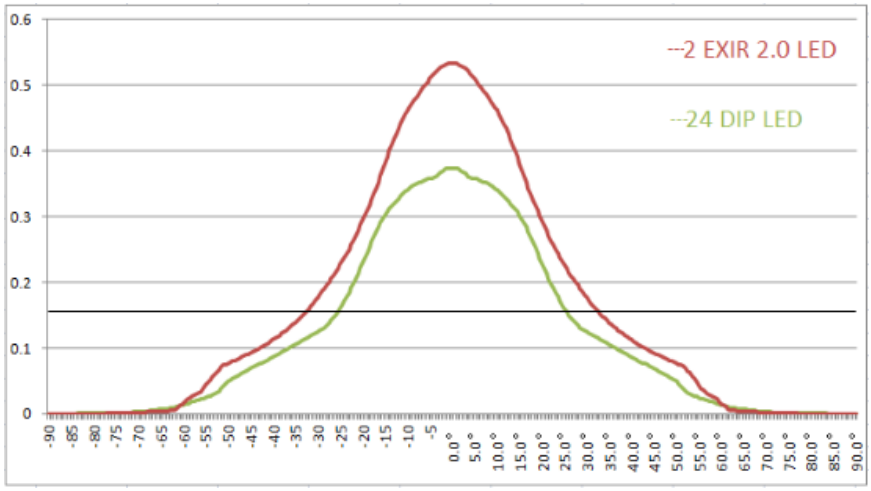

Figure 18**.** Luminous power comparison between EXIR 2.0 and DIP IR LED

3.6 Better infrared uniformity

The beam angle of EXIR 2.0 is precisely designed according to the FOV of Hikvision camera. It not only enables high light utilization but also ensures uniformity. And there is no dark areas in the image. See the comparison below:

Figure 19. Infrared performance of EXIR 2.0

Figure 20. Infrared performance of DIP LED

3.7 Better heat dissipation

The heat dissipation of DIP LED is poor because it conducts heat by two leads. And thermal resistance is very large, about 140°C/W. But the EXIR 2.0 adopts EMC encapsulation. It dissipates heat by the metal pad which has large heat dissipation area and small thermal resistance, about 3-5°C/W.

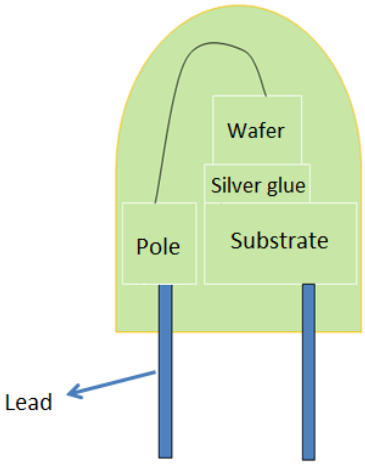

Figure 21. DIP LED structure

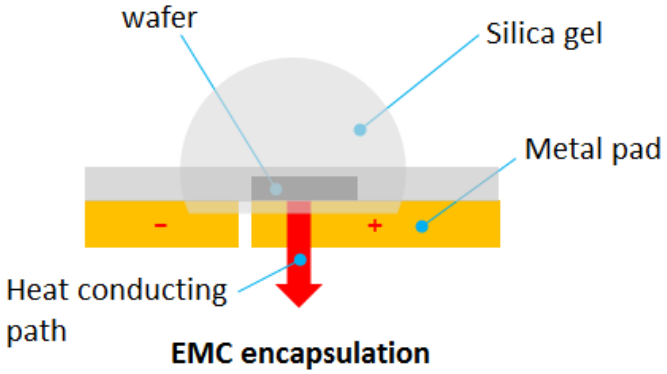

Figure 22. EXIR 2.0 structure

3.8 Longer lifespan

Infrared LED's lifespan is mainly limited by temperature. Due to the aging of chip or encapsulation material, the LED's lifespan get shortened. The following diagram shows the life curves of EXIR 2.0 and DIP LED under the

temperature of 105°C. According to LM60 standard, the DIP LED's lifespan is 20000 hours and EXIR 2.0's lifespan reaches 40000 hours.

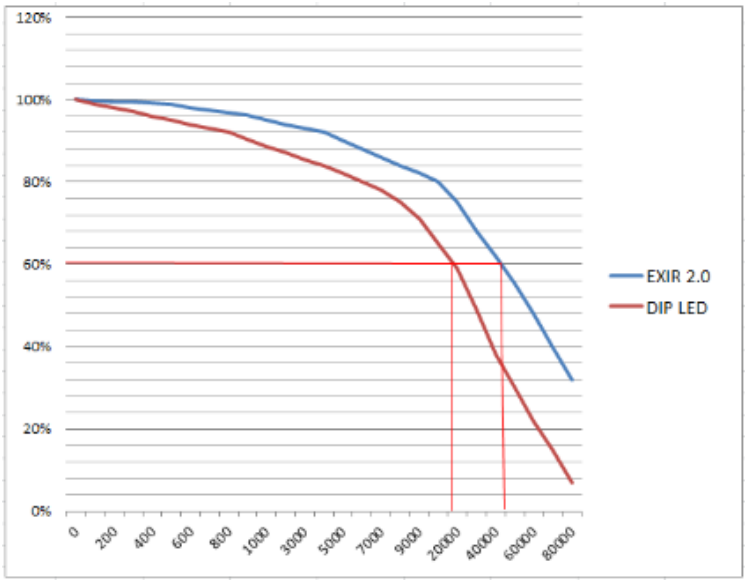

Figure 23. Life curves of EXIR 2.0 and DIP LED

3.8 More Compact Camera Design

The brightness of EXIR 2.0 is higher, so compared with DIP LED, its infrared board is smaller under the same brightness. Consequently, it can be applied to camera with smaller size, bringing customer more choices.

Appendix 1 Comparison of Main Parameters Between EXIR 2.0, EXIR 1.0 and DIP LED

Parameters	EXIR 2.0	EXIR 1.0	DIP LED
Lifespan	30000-40000 h	20000-30000 h	< 20000 h
Luminous efficacy	40-45%	35-40%	30-40%
Emitting method	Surface emitting	Surface emitting	Body emitting
Emitting uniformity	Good	Good	Common
Thermal resistance	3-5 °C/W	8-12 °C/W	140 °C/W