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LED

a kind of Unconventional Lamp
「發光二極管」 - 非一般的燈

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1) Purpose 目的

The purpose of this booklet is to provide an introduction to the applications and energy saving potential of the Light Emitting Diode (LED) lamps.

With the advancement of LED technology in recent years, the use of LED lamp becomes more widespread and popular due to its long service life, versatile colour changing ability and low power consumption.

本小冊子旨在介紹一些有關「發光二極管」的應用和節約能源的潛質。

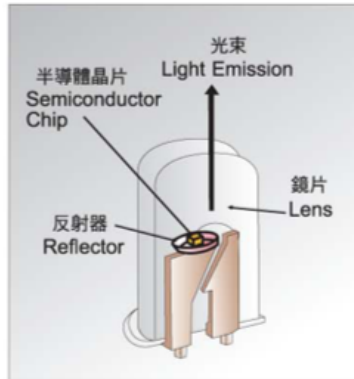
隨著近年來科技的進步，「發光二極管」的很多優點，都得到充分發揮；由於耐用和色彩變化萬千，加上低耗電量，使它的應用層面越見廣泛。

2) Technical Information 技術性資料

2.1 Construction of LED

Unlike conventional lamps, LED has no filament or breakable glass bulb, and it generates very little heat.

LED is a semiconductor chip supported by a reflector and encapsulated with an epoxy lens for controlling light distribution. When a DC voltage (typically



2.1 「發光二極管」的構造

「發光二極管」的構造與常用的燈泡截然不同，它既沒有燈絲，也無易打破的玻璃罩，而且只有少量熱能散發。

「發光二極管」是將一顆半導體晶片嵌裝在反射器上，再以樹脂加以密封，形成

from 2.3 to 4.5 volt) is applied, the electrons flowing through the chip will cause emission of electromagnetic wave (light) at certain frequency (colour). Emitting monochromatic visible light of different colour is made possible by selecting different semiconductor materials.

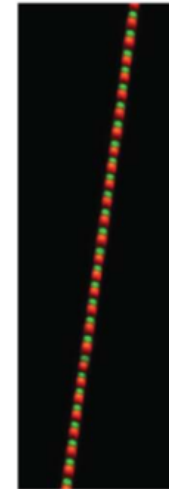
一片導引光線散發的鏡片。當接上直流電源（通常是由2.3到4.5伏特），流經晶片的電流會使晶片產生某一頻率（或顏色）的電磁波（或光線），透過改變製造半導體的物料，「發光二極管」便可發出不同顏色的光線。

2.2 Colour of LED Light

Colour of light output from a LED depends on the semiconductor materials used in the chip which require different voltages to enable electron flow. Nowadays, common light colours available are red, red-orange, amber, green, cyan and blue. By blending different colours, usually red, green and blue, LED may produce almost all range of colours.

2.2 「發光二極管」的多種顏色

不同顏色的「發光二極管」使用不同的半導體物料製造，其所需的推動電壓亦會不同。目前較常見的顏色有紅、橙紅、黃、綠、青和藍。其他的顏色則可以透過混雜紅、綠和藍三色而獲得。



2.3 Power Rating

The power rating of a LED depends on its rated carrying current and the required terminal voltage to drive this current.

The current determines the light intensity of a LED and different colours of LEDs have different terminal voltages.

Hence, LEDs with same light intensity but different colour will consume different power as shown in Table 1.

Traditional LEDs are rated at tenths of a watt while the high brightness LED can reach 5 watt.

2.4 Efficiency

Efficiency of a lamp (also called luminous efficacy) is defined as the luminous flux in lumen per unit lamp power. Table 1 compares the typical luminous efficacy and life expectancy of different colours of high power 1W LEDs commonly available in the

2.3 功率

一顆「發光二極管」的功率，取決於其額定電流和達致該電流所需的兩極電壓；電流量會影響其光度而不同顏色的「發光二極管」有不同的兩極電壓。因此，於相同亮度下，不同顏色的「發光二極管」，就有不同的耗電功率（詳情如表一中所列）。傳統的「發光二極管」，其功率不外乎在0.1瓦左右，但現今高光亮度的「發光二極管」的功率已達致5瓦。

2.4 效能

燈泡的效能（或稱「燈光效率」）是指每1瓦燈泡耗電所能產生的「光通量」（單位為「流明」）。表一列出了不同顏色的1瓦高功率「發光二極管」和其他常用燈泡的「燈光效

market with conventional lamps. It is worth noting that the luminous efficacies of LED have been improving steadily.

率」和壽命以作比較。值得我們留意的是高功率「發光二極管」的「燈光效率」正持續提升。

光源 Light Sources		燈光效率 Luminous Efficacy (流明 / 瓦 Lumen/Watt)	壽命 Life Expectancy (時數 Hours)
1瓦高功率 「發光二極管」 High Power 1W LED	紅 RED	37	50,000
	橙紅 RED-ORANGE	48	50,000
	黃 AMBER	37	50,000
	綠 GREEN	40	50,000
	青 CYAN	34	50,000
	藍 BLUE	12	50,000
	白 WHITE (配發光料 phosphors-converted)	34	50,000
白 WHITE (混色 colour blending)	30	50,000	
白熾燈 Incandescent Lamp (25瓦W)		9	3,000
T8 熒光燈 Fluorescent Lamp (18瓦W)		70	12,000
T5 熒光燈 Fluorescent Lamp (14瓦W)		90	18,000
綜合式緊湊型熒光燈 Integrated Compact Fluorescent Lamp (11瓦W)		55	6,000
綜合式無極感應燈 Integrated Induction Lamp (23瓦W)		70	60,000

表一：各類光源的「燈光效率」和壽命比較一覽表

Table 1 : Comparison of Luminous Efficacy and Life Expectancy of Different Lamp Types

3) Advantages of Using LED 使用「發光二極管」的優勢

3.1 Robust and Reliable

LED has no filament and breakable glass bulb. Therefore, it is very robust and reliable in many applications.

3.2 Long Service Life

The service life of LED is mainly determined by the depreciation of light output. A LED is generally considered reaching end-of-life when its light output drops by more than 30%. High quality LED that works properly within its temperature limit will only reach this point after running for 50,000 hours (i.e. 5.7 years continuously). Such a long service life makes LED particularly suitable for use in areas with harsh maintenance constraints.

3.3 Versatile Colour Changes

Apart from switching ON and OFF, controlling LED's light intensity can easily be achieved by adjusting the

3.1 堅實及可靠

「發光二極管」沒有可衰微的燈絲，也沒有可打破的玻璃罩，所以比其他燈泡更堅實和可靠。

3.2 耐用

「發光二極管」極耐用，其壽命取決於其光通量的衰減程度，當光通量衰減了30%時，一般會被認為是使用期滿；高質素的「發光二極管」，若沒有超溫工作，其壽命可達5萬小時（即不停使用5.7年）。在一些有維修限制的場地，「發光二極管」便能大派用場。

3.3 多幻變色彩

「發光二極管」的控制並不限於開關，透過控制電流量，燈的亮度便可隨意

current. Since LED responds quickly to both switching and dimming, it is very suitable for dynamic lighting effect. This can easily be done with digital controller and computer program.

3.4 Environmentally Friendly

LED is comparatively more environmentally friendly than conventional lamps. It has a much longer life and hence helps waste reduction.

調控；加上「發光二極管」對調控訊號反應迅速，因而更適用於閃動及變幻的照明效果，只要配上數碼控制器和電腦控制程式便可。

3.4 保護環境

「發光二極管」比傳統燈泡環保，因它更耐用，能間接減少廢物產生。

4) Applications 應用

4.1 Exit Sign

Exit signs which are lit round-the-clock throughout the year, consume a substantial amount of energy. The use of LEDs for exit signs can save more than 80% energy than traditional fluorescent light exit signs.



4.1 出路指示牌

由於出路指示牌全年每日24小時點亮，不斷消耗能源，若將熒光燈出路指示牌改為「發光二極管」出路指示牌，可節省超過8成的能源。

出路指示燈 Exit Sign Lighting	消耗功率 Power Consumption (瓦W)	每一指示牌每年耗電量 Annual Energy Use per Unit (千瓦時 kWh)	使用「發光二極管」 比其他節約 Relative Energy Savings of LED
18W T8 熒光燈 Fluorescent Lamp	31	271.6	88%
14W T5 熒光燈 Fluorescent Lamp	26	227.8	85%
「發光二極管」LED	3.8	33.3	--

4.2 Building Facades Lighting

Owing to the versatile colour changing characteristic, robustness and low power consumption of LED, more and more buildings adopt LED for facades decorative lighting.



The average system luminous efficacy for multi-colour applications of LEDs is around 30 lumen per watt while it is only 9 lumen per watt for incandescent lamp bulbs. Hence there can be a 70% energy savings by using LED lamps instead of conventional lamps.

4.2 大廈外牆照明系統

因為「發光二極管」有多變幻色彩的特性，而且堅實兼省電，越來越多大廈採用「發光二極管」作為外牆裝飾燈。

使用「發光二極管」去取代白熾燈，作為大廈外牆裝飾，可節省7成電力，這是由於有多種顏色的「發光二極管」裝置，其燈光效率平均約為每瓦30個流明，而傳統白熾燈則每瓦只有9個流明。

4.3 Traffic Signal

Conventional traffic signals use tungsten halogen lamp bulbs. In recent years, more and more cities adopt LED traffic signals. This is because LED traffic light can save over 70% of the energy comparing with traditional traffic light. Apart from saving energy, it also saves maintenance cost as LEDs have much longer service life. In Hong Kong, replacement of conventional traffic lights with LED traffic lights is also underway.



4.3 交通燈

傳統交通燈使用鎢絲鹵燈操作。近年來，世界各地有多個城市，已使用「發光二極管」作為交通燈，使消耗於交通燈的電力大減7成；其次，耐用的「發光二極管」也減省了可觀的維修費用。香港的交通燈也正逐步改用「發光二極管」。

4.4 Areas with High Lamp Replacement (Maintenance) Cost

Long service life of LED makes it suitable for applying in areas with harsh environment for lamp replacement, such as high level facade.



4.4 高難度更換燈泡的場合

「發光二極管」較耐用，因此適用於有高難度更換燈泡的場地，例如是外牆的高處。

4.5 Projector

High brightness LED when used to replace the halogen lamp in LCD projector can make the projector more handy and durable.

This type of LCD projector for short distance projections may just weigh 0.5 kg and the energy savings will be around 40% as compared with halogen lamps.



4.5 投影机

高亮度「發光二極管」的另一應用範疇，是取代液晶顯示投影器中的鹵燈，使投影器變得更輕巧耐用。

市面上有用作短距離投射的液晶顯示投影器，是使用「發光二極管」作為光源，重量只有0.5千克，不單方便攜帶，能源消耗也節省了4成。

4.6 Landscape Lighting

LEDs are robust and consume little energy and they can easily be powered by solar energy.



4.6 園景燈飾

「發光二極管」用電量少，又耐用，容易配合太陽能光伏板使用。

4.7 Other Miscellaneous Applications

We can also find wider applications of LED in our daily life, like vehicle rear light, torches, table lights, decorative lamps etc.



4.7 其他例子

日常生活中，人們不難發現，使用「發光二極管」已漸趨普遍，例如汽車的尾燈、手電筒、檯燈、裝飾蠟燭燈檯等。

5) Precaution 小心使用

LEDs produce very bright directional light. It is recommended not to stare at the light beam of any LED at close distance.

因「發光二極管」能發出極強的光束，故不宜近距離凝視光源。

For further information or enquiry, please contact EMSD or visit our website by referring to the details on the back page.

如須獲得進一步資料或有任何查詢，請聯絡機電工程署或上本署網址，詳情載於背頁。