

Introduction of LED

WHY LED?

Energy consumption and global warming lead to the human beings pay attention to find solutions for “environmental protection” and “energy conservation”, apparently either environmental protection or energy conservation is a concept of decreasing the quantity of energy used. On the basis of energy conservation, Light Emitting Diode(LED) is chosen as the new power to replace the traditional lighting to achieve the goal. LED has all advantages of the energy-saving, low heat, low power consumption, long-lived and does not contain hazardous element(Mercury), provides the best substitution of general lighting.

Due to the luminous efficacy of LED has been tremendously proved in the past years, especially all makers paid more attention on developing High Power LED, additional the demand of energy saving, LED, since the 21st century, becomes the most important popular expectation of general lighting.

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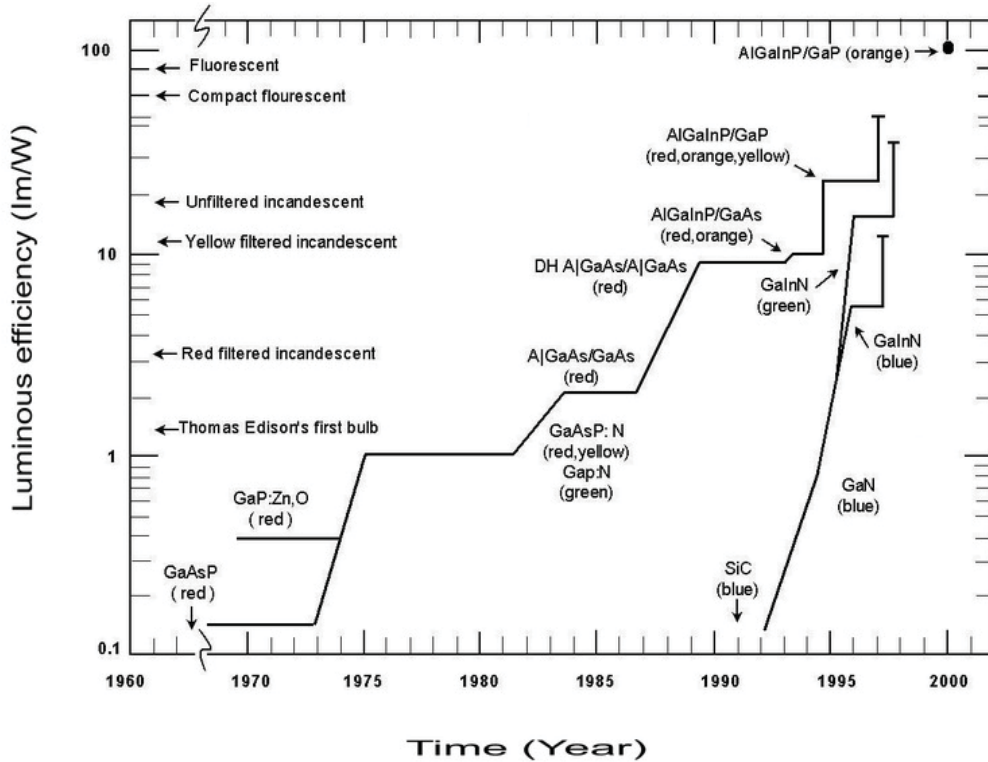


Diagram 1.: The Brief History in LED Development

LED General Lighting Development

Since the end of 20th century, LEDs have been considering as the innovative lighting source. Some advanced countries, for instances, Euro Union has achieved a common view that eliminate the white heat lighting gradually since 2007, Australia made an announcement to prohibit the white heat as well from 2010, and U.S. Department of Energy predicts that LED can bring down the electricity of lighting to 33% compare with white heat source in 2025 (*ITRI:2007*), famous Lighting source suppliers in these countries just like Osram and Philips keep the step working on this issue. This section is giving an implantation of current status of LED

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lighting industry.

The Indoor/Outdoor Lighting Development of LED

The indoor decoration LED Lighting market becomes mature and strong because of its atmosphere made from LED, emphasizing the high level elegance and variety in colors, mostly accepted in some advanced countries.

On the other hand, LED lighting source is not looking for only a niche market since the long term purpose should be more popular, create wider market. In outdoor application needs improvement in some technical specifications of color rendering and luminous efficacy.

U.S. Department of Energy provides a formula to compute the luminous efficiency to compare LED sources to CFLs, for example, the most basic analysis should compare lamp-ballast efficacy to LED+driver efficacy in lumens per watt. Data sheets for white LEDs from the leading manufacturers generally provides "typical" luminous flux in lumens, test current (mA), forward voltage (V), and junction temperature (T_j), usually 25 degrees Celsius. To calculate lm/W, divide lumens by current times voltage. As an example, assume a device with typical flux of 45 lumens, operated at 350 mA and voltage of 3.42 V. The luminous efficacy of the LED source would be:

$$45 \text{ lumens} / (.35 \text{ amps} \times 3.42 \text{ volts}) = 38 \text{ lm/W}$$






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To include typical driver losses, multiply this figure by 85%, resulting in 32 lm/W. Because LED light output is sensitive to temperature, some experts recommend de-rating luminous flux by 10% to account for thermal effects.

As time goes by, the development of LED lighting (luminous, life, color rendering and temperature control) has also proved the possibility to substitute the conventional lighting in the coming 3-5 years. Following table shows the developing history.

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❖ Development of LED General Lighting Application

Conventional vs LED		2001	2002	2003	2004	2005	2006~
		Halogen Incandescent	White Heat(Tungsten Wire)	Fluorescent(CFL)	Fluorescent(PL Type)	Fluorescent(Linear)	HID
							
Emitting Efficiency(lm/w)	Conventional Light Source	18	40	40	50	65	90
	White High Power LED	20	30	40	50	60	120
Color Rendering(%)	Conventional Light Source	100	100	80-85		60-75	85
	White High Power LED	50-60					
Color Temperature(kalvin)	Conventional Light Source	2800-3000	2900-3200	2700-7000		4000-6500	3000-7000
	White High Power LED	3300-6500					
Life(khr)	Conventional Light Source	0.5-1	1-3	3-6		10-20	25-30
	White High Power LED	100					

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Strengths in LED Lighting: (Compare with conventional sources)

- (1) LEDs produce more light per watt than incandescent bulbs; this is useful in battery powered or energy-saving devices.
- (2) LEDs can emit light of an intended color without the use of color filters that traditional lighting methods require. This is more efficient and can lower initial costs.
- (3) When used in applications where dimming is required, LEDs do not change their color tint as the current passing through them is lowered, unlike incandescent lamps, which turn yellow.
- (4) LEDs' being solid state components, are difficult to damage with external shock. Fluorescent and incandescent bulbs are easily broken if dropped on the ground.
- (5) LEDs mostly fail by dimming over time, rather than the abrupt burn-out of incandescent bulbs.
- (6) LEDs do not contain mercury, unlike compact fluorescent lamps.
- (7) LEDs can have a relatively long useful life. One report estimates 35,000 to 50,000 hours of useful life, though time to complete failure may be longer. In fluorescent lamps, photochemical degradation of the phosphor coating and accumulation of light-absorbing deposits cause lumen depreciation. Compact fluorescent lamps (CFL) generally lose no more than 20% of initial lumens over their 10,000 hour life.



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High-quality linear fluorescent lamps (T8 and T5) using rare earth phosphors will lose only approximately 5% of initial lumens at 20,000 hours of operation. (*Knau:2000, IESNA Lighting Handbook.*)

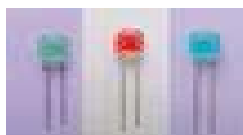
(8) LEDs light up very quickly. A typical red indicator LED will achieve full brightness in microseconds. Philips Lumileds datasheet of DS23 for the Luxeon Star states “less than 100ns.”

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Introduction of LED Component Package Types:

LED components are produced through die bonding, wire bonding and package in various types which are list as following:

- Miniature LEDs(Dip LEDs, Through LEDs or Lamp LEDs)



Miniature LEDs

Miniature LEDs are mostly single-die LEDs used as indicators, and they come in various-size packages, generally are 3mm, 5mm, 8mm and 10mm, also available in other sizes, but less common. For classification in package shapes, can be attributed in round, dome top, flat top, rectangular, flat top...etc. commonly.

Regarding the function, there are three main categories of miniature single die LEDs:

Low current — typically rated for 2 mA at around 2 V (approximately 4 mW consumption).

Standard — 20 mA LEDs at around 2 V (approximately 40 mW) for red, orange, yellow & green, and 20 mA at 4–5 V (approximately 100 mW) for blue, violet and white.

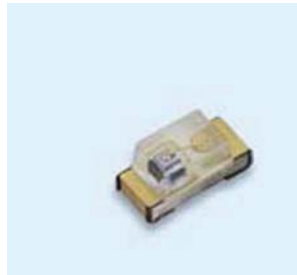


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Ultra-high output — 20 mA at approximately 2 V or 4–5 V, designed for viewing in direct sunlight.

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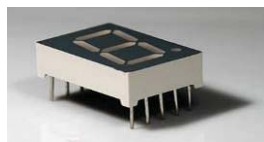
● Surface Mount LEDs(SMD LEDs)



Surface Mount LEDs

Surface Mount LEDs are mostly used for backlighting application in LCD, mobile phone, can be categorized in side view, top view, and PLCC type, the technique of two or three chips mounted in one LED also available.

● Alphanumeric LEDs(Seven Segments Display LEDs)



Alphanumeric LEDs

LED displays are available in seven-segment and starburst format. Seven-segment displays handle all numbers and a limited set of letters. Starburst displays can display all letters. Seven-segment LED displays were in widespread use in the 1970s and 1980s, but increasing use of

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liquid crystal displays, with their lower power consumption and greater display flexibility, has reduced the popularity of numeric and alphanumeric LED displays. Usually applied in elevators

High Power LEDs(Lighting LEDs)



High Power LEDs

Since the beginning of 21st century, all LED component makers have been developing so called” High Power LEDs”, these are the most suitable package type to replace conventional lighting. Normally high power means LEDs’ driving current can achieve 350mA or above, and its luminous efficacy approach 60 lumen per watt, currently Seoul Semiconductors Inc. at Korea and Nichia in Japan are both recognized the leaders in high power LEDs development within Asia, Seoul successfully produces LEDs that can run directly from mains power without the need for a DC converter. For each half cycle part of the LED diode emits light and part is dark, and this is reversed during the next half cycle. Current efficiency is 80 lumen per watt; (*LEDsMagazine.com: 2006*) Nichia created the product with 100 lumen per watt in 2007

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LED applied for Lighting

- Light bulbs
- Streetlights
- Large scale video displays
- Architectural lighting
- Motorcycle and Bicycle lights
- Flashlights, including some mechanically powered models.
- Emergency vehicle lighting
- Stage lights using banks of LED's as replacement for incandescent bulbs. LED's produce less heat so LED stage lighting is cheaper to operate and reduces the risk of fire considerably.
- LED-based Christmas lights have been available since 2002.

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LED LIGHTING FAQ

Question 1: What is LED differ from traditional lighting source?

Answer :

Traditional Lighting VS LED Lighting		
	Traditional Lighting	LED Lighting
Life Span	200 Days(10 Hrs. per day)	2000Days(10 Hrs. per day)
Efficiency	20-25LM/W	70-100LM/W
Production	Simple	Complicated
Cost	Low	High
Reaction	Slow, Flash	Quick, Non-Flash
Miscellaneous	Mercury contained , recycle needed	No Mercury
Sources: IEK		

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Question 2: Why LED is more “energy-save”?

Answer:

Comparison of Electricity Consumption(Per Month)						
Lighting Source	Consumption Wattage	Estimation of total operating hrs. per month (10hrs per day)	Total Electricity Consumption(°)	Electricity Rate/1W (Currency: US)	Estimated Amount(US)	Remark
Tungsten Bulb(60W)	60	10 hrs×30 days=300	18	0.1	1.80	20 times than LED Bulb
Fluorescent Tube(20W)	25	10 hrs×30 days=300	7.5		0.75	2 times than LED TUBE
Energy Save Bulb	17	10 hrs×30 days=300	5.1		0.51	5times than LED Bulb
LED 3W Bulb	3	10 hrs×30 days=300	0.9		0.09	Lowest
LED 10W T10 TUBE	12	10 hrs×30 days=300	3.6		0.36	Starter and Ballast are not necessary

*According to Taiwan Power Company’s website to refer the formula of calculation
(http://www.taipower.com.tw/TaipowerWeb/upload/files/11/main_3_6_3.pdf)

*Electricity Unit(°)=(Consumption Power x hrs) /1000

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Question 3: I heard that LED is quite costly, can you give me a reason why I should buy it?

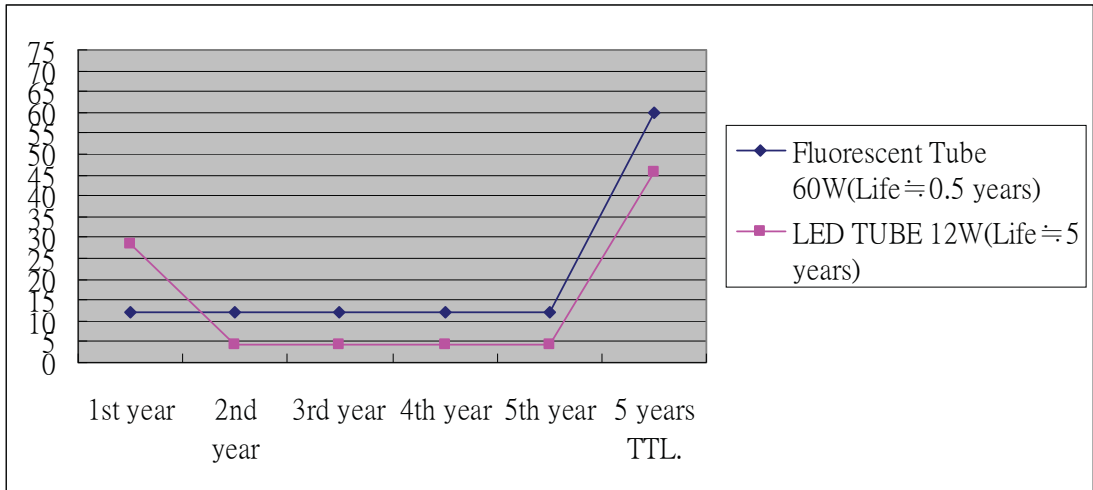
Answer:

Comparison of Total Expense(Fluorescent Tube 20W vs T10 LED 12W TUBE)						
Lighting Souce	Year	Yearly Lamp Consumption Qty	Unit Price(US)	Yearly Comsuption Amount(UP x Qty)	Electricity Fee	Total.
Fluorescent Tube 60W(Life≈0.5 years)	1st year	2	1.5	3	9	12
	2nd year	2		3	9	12
	3rd year	2		3	9	12
	4th year	2		3	9	12
	5th year	2		3	9	12
	5 years TTL.	10		15	45	60
Lighting Souce	Year	Yearly Lamp Consumption Qty	Unit Price(US)	Yearly Comsuption Amount(UP x Qty)	Electricity Fee	Total.
LED TUBE 12W(Life≈5 years)	1st year	1	24	24	4.32	28.32
	2nd year	0		0	4.32	4.32
	3rd year	0		0	4.32	4.32
	4th year	0		0	4.32	4.32
	5th year	0		0	4.32	4.32
	5 years TTL.	1		24	21.6	45.6

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*According to Taiwan Power Company's website to refer the formula of calculation (http://www.taipower.com.tw/TaipowerWeb/upload/files/11/main_3_6_3.pdf)

*Excluded the cost of starter and ballast(LED TUBE does not need BALLAST or STARTER)



Except 1st year, from 2nd year you can find the difference and please don't forget LED doesn't need starter or ballast, and the price will getting lower by year, and you don't need to think about recycle problem since there is no Mercury or any other hazardous elements inside LED Tube

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Question 4: How to compare the brightness between LED TUBE and regular Fluorescent TUBE?

Answer:

More importantly, since all the light is being directed down, the configurations are different, in the fluorescent, the light is in a 360 degree plane and about 40% of the light is lost. In LED, all the light goes down and directly out, assuming an LED at 1600 lumens and a fluorescent lamps at 2800 lumens, the actual LUX at a distance should be comparable to the fluorescent”.

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Question 5: How to tell the specification of T8/T10?

Answer:

T10 and T8 are mutually replaceable.

“T “ means the diameter and equals 1/8 inch, so T8 =1 inch=2.54cm, T10=3.18cm, however, T10 and T8 in LED tube stands for the difference in the cover shell size, the distance between T10’s 2 PINS(cap) and T8’s 2PINS(cap) is the same length.