

Application Notes: New high-power LED driver

LED brightness depends on the current high or low, while for the same color LED, they have the same current but different forward voltage. While different colors, LED have neither the same drive currents nor forward voltage. Figure 1. shows a variety of high-brightness LED's relationship between forward voltage and drive current.

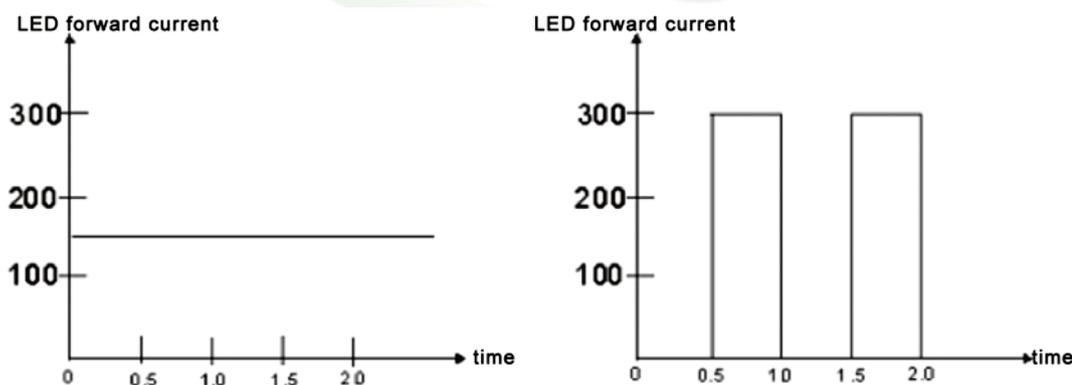
Figure 1.

Emitting Coio	Forward Current	Power Dissipation	Forward Voltage		Wave length		Luminous Flow	
	Typ.	Typ.	Min.	Max.	Min.	Max.	Min.	Max.
Pure White	350	1.15	3.00	3.80	5000	8000	50	100
Warm white	350	1.15	3.00	3.80	2300	3800	40	70
Blue	350	1.15	3.00	3.80	460	470	6	20
Green	350	1.15	3.00	3.80	520	530	50	80
Visual Purple	350	1.15	3.00	3.80	380	410	0.5	1
Red	400	0.96	2.00	2.80	620	630	35	60
Yellow	400	0.96	2.00	2.80	585	595	35	60
Infrared	600	0.96	1.20	2.00	850	940	/	/

Because of different application environments the power has some changes for the output voltage, LED's forward voltage is different, in order to ensure optimum LED performance and long working life, we need an effective constant current drive, rather than voltage source control. Then, as to constant current mode driver LED, how to achieve brightness adjustment? There are two methods, one is simulating dimming mode, the other is the pulse width (PWM) dimming. However, simulating tune is just completed by reducing the LED current. This way in regulating the LED brightness LED can also lead to some chroma changes at the same time (hue and saturation are regarded as the chroma, hue determine the nature of color categories, color saturation is as the colour depth).

The use of pulse width (PWM) dimming is an effective way to avoid the chromaticity deviation for the current changes. PWM tune just ensure the LED current not any changeable. By changing the current on and off ratio the power is able to achieve the brightness adjustment. For example, it needs to control the LED brightness at 50%, then as long as connecting current at each cycle was controlled at 50% open, analog dimming and PWM dimming is shown as Figure 2.

Figure 2.



The distinction between LEDD10 products series and traditional products:

LEDD10 is a constant current source, constant output current (current is within the range of stability). The output voltage value depends on the input voltage and load. When the drooping between input and output is fixed, the output voltage value only depends on the output load (equal to the sum of all the LEDs' voltage drooping). Company's traditional product is a voltage source. When load is between the minimum and maximum value and the output voltage value is constant, the output current depends on the output voltage and output load.

LEDD10 series application field

LEDD10 products are designed to drive high-power LED for constant current output driver, and apply to drivers of 1W ~ 3W different specifications high-power LED lights, can drive up to 10 series LED lights, providing about 1W ~ 20W output power, efficiency up to 95%. This series of drives is in small size packages, small volume, wide input voltage range, with the highest 10KHz the PWM dimming function and ON/OFF control, -40 °C ~ +85 °C temperature range, is a cost-effective products. Its wide range of applications, mainly include:

- 1.) applies to the automotive industry for driving LED lights of vehicles, applications ranging for car display panel, decorative lights, lights, to car brake lights, turning lights, indicator lights and so on.
- 2.) Room decorative lighting for hotels, bars, shopping malls and other places to drive LED lights are to create a good atmosphere.
- 3.) For landscape lighting it can be applied to supply power for LED guardrail lights, buried lights, tree lights, underwater lights, lanterns.
- 4.) it can be applied to for driving LED emergency lights, flashlights, lighting for cultural relic and artistic works, leather and jewelry lights, lights for crop growth, solar power LED lights and so on.
- 5.) In the transport field, transport can be applied to power supply for LED lights, LED lights.

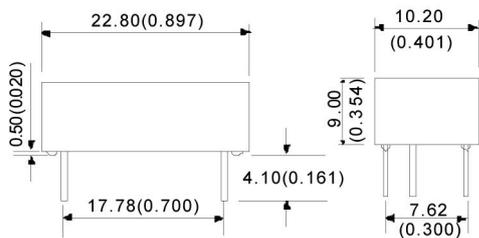
General characteristics					
Item	working conditions	Min	Typ	Max	unit
Input voltage				40	VDC
input filter		capacitor			
Output current accuracy	Vin=24V, 5 LEDES		± 5	±8	%
Output current stability	Vin=24V, 1LED to 5 LEDES		±5	±10	
Temperature coefficient	-40 °C ~ +71 °C ambient			± 0.03	%/°C
Output short circuit		Continue			
Operating temperature range	300mA / 350mA	-40		85	°C
	500mA/ 600mA/ 700mA	-40		71	
Storage temperature range		-55		125	
Maximum shell temperature				100	
Maximum capacitive load			470		µF
MTBF	MIL-HDBK-217F (+25°C)		2,000,000		Hours
Case materials		heat-resistant plastic			

General characteristics					
Item	working conditions	Min	Typ	Max	unit
weight			3.5		
PWM dimming & on / off control (hang for no using)					
On/off control	On	Hang or 2.8V <math>V_c < 6V</math>			
	Off	$V_c < 0.6V$			
Switch control end current	$V_c = 5V$			1	mA
Static input close mode	$V_{in} = 24V, V_c < 0.6V$			400	μA
PWM dimming frequency			0.2	10	KHz

Product LEDD10 series models, input and output parameters and conversion efficiency

Product Type List						
Part number	Input Voltage (V)		output		dimming	Efficiency (% ,max)
	Rating value	range	voltage(VD)	current(mA)		
LEDD10	24	5.5-36	2-32	0-300	PWM dimming	95
LEDD10	24	5.5-36	2-32	0-350	PWM dimming	95
LEDD10	24	5.5-36	2-32	0-500	PWM dimming	95
LEDD10	24	5.5-36	2-32	0-600	PWM dimming	95
LEDD10	24	5.5-36	2-32	0-700	PWM dimming	95

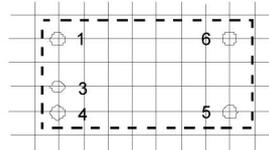
LEDD10 series packaging and mechanical dimensions:



Note
Unit: mm[inch]
Pin section tolerances: 0.1mm[0.039inch]
General tolerances: 0.25mm[0.010inch]

Third Angle Projection 

RECOMMENDED FOOTPRINT
Top view, grid: 2.54mm(0.1inch)
diameter: 1.00mm(0.039inch)



FOOTPRINT DETAILS

Pin	Function	Comments
1	V _{in}	DC Supply
3	ON/OFF/PWM	Leave open if not use
4	GND	Do not connect to -V _{out}
5	-V _{out}	LED Cathode connection
6	+V _{out}	LED Anode connection

Typical applications LEDD10 Series

1 PWM dimming control circuits:

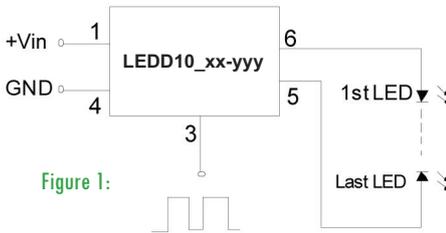


Figure 1:

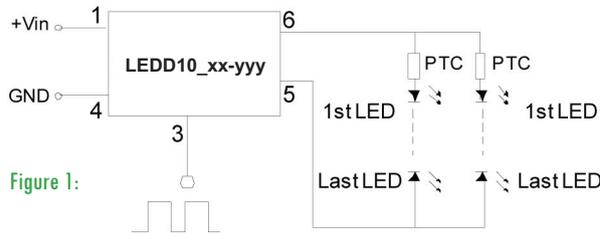


Figure 1:

2 EMI filter circuit Recommend:

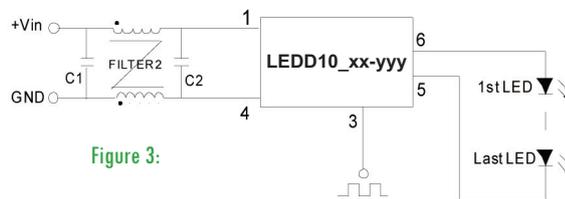


Figure 3:

In the course of application, if necessary for the protection of LED, it can be add a positive temperature coefficient PTC components of protection at the front of each branch, as shown in Figure 2.

LEDD10 series PWM dimming control Instructions

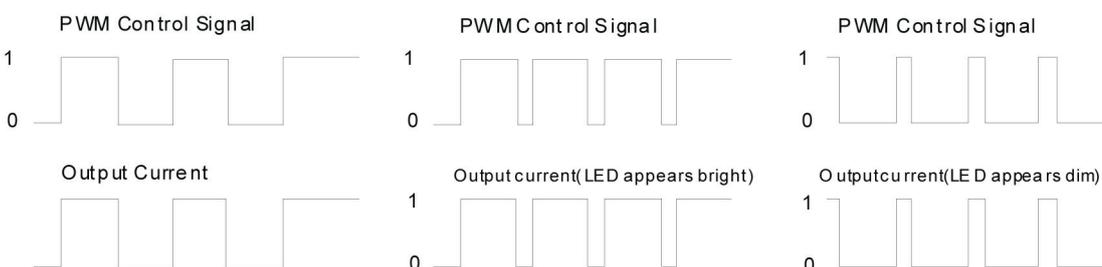
In order to avoid naked eye seeing the LED turn-on and the turn-off, as usually, the requirements for PWM dimming frequencies must be higher than 100Hz, so that the eyes will be able to balance the time for on/off. We can only see the effective brightness depending on the PWM duty cycle. LED color will not be like Analog dimming as change by PWM dimming. PWM dimming can control LED brightness, and ensure the LED's light chroma stable as well. For a certain frequency PWM dimming, the range of dimmable LED depends on the rate of current rise which can be calculated from the time required from close to the output value. For instance, LED current from the time turn-off to the output value is for 10µS, the PWM dimming signal is a frequency of 200Hz, and its dimming range is calculated as follows:

$$T_{pwm} = 1/200S,$$

$$T_{on} = 10\mu S$$

the PWM Minimum dimming range $(T_{on}/T_{pwm}) \times 100\% = 0.2\%$, dimmable range of 0.2% -100%.

Current through the LED is proportional to the PWM dimming signal duty cycle, so that as long as calculating the ratio of the required LED current setting value and rating, you can be sure the PWM dimming signal duty cycle, by controlling the PWM duty cycle to achieve the adjustment of LED brightness. For example, the drives rated output value is 300mA, to set LED current is 150mA, the ratio between them is 1:0.5, as long as the PWM dimming control signal duty cycle is also 0.5, then drive's output current is the current value which need (as figure below). It should be noted that during the PWM dimming the driver will have some noise which is normal, because PWM dimming frequencies is within the human ear's hearing frequency range (typically 20Hz-20KHz).



LEDD10 series Application notes

1. If the input converter's output ripple is rather large or is with a long down-lead, it need to add filter capacitor in the input end; because of practical applications are in the different environmental conditions, there are always some uncertain interference signal into input end which is likely to affect drive's normal operating condition, so at the drive input end requires filter capacitor, a recommend value is 47 μ F, if the output has a relatively heavy load may be appropriate to increase the value of input capacitance.

2. at the drive's output end need to link with a 2.2 μ F-22 μ F of capacitance and voltage values should be 1.5 times higher than the input voltage. Smaller ESR is better, which could make the LED current flow more smooth, LED shine get better performance.

3. LEDD10 driver series should not be as a hot-swappable power supply; in the process of testing or use it should be avoided for their hot-plug operation, otherwise they will damage user and even damage the driver.

4. Many drives are operated at the same time, if we find that there is mutual interference, then at each drive input need connecting with an EMI filter to ensure that each drive can work steadily and reliable.

5. LEDD10 series drivers is applied to +71 °C or +85 °C of maximum environmental temperature. If the actual ambient temperature is in high-temperature status for long-term, in view of LED life, the selected driver's output current rated specifications should be de-rated. As the temperature of LED light rises higher, light failure become sooner, the life expectancy gets shorter. For example, if the application of the LED's current specifications is 350mA, you may choose to 300mA output current specifications for the driver.

6. LED and LED driver design circuit and application LED has been widely applied in lighting, decorative lamp type products, in the design of LED lights, it needs to consider what kind of LED drive, and LED are used as a load in series or parallel mode. The fit design circuit can ensure LED work smoothly.

a) LED in series mode: in this model driver has the output high voltage. The pressure difference between the input and output voltage must meet the requirements on the technical manuals, otherwise the driver's output will be abnormal. For this connection mode when the LED's consistency is rather different, although the LED voltage is different, for each LED's current is the same, the brightness of each LED is basically the same. LEDD10 series driver is constant current drive, so when an LED is a poor quality for short-circuit, because the driver output current remains unchanged, all the LED does not affect the remaining work. When a poor quality one LED disconnect, the series of the LED lights will be totally disregarded. The solution is link with a zener in each LED. Of course, zener pressure is required higher than the LED voltage turn-on voltage of the high, otherwise the LED will not light.

b) LED in parallel mode: this mode requires a larger output current and lower load voltage for LED driver. At both ends of all the LED has the same voltage, when LED consistency is quite different, the current through each LED is different, then the LED brightness will be different. Pick out the better consistency for LED, suitable for lower supply voltage products (such as solar power or battery-powered).

When the current drive is constant drive, if a poor quality LED is disconnected, due to output drive current remains unchanged, the distribution of the remaining LED current will increase, leading to easy to damage all the LED. Solution is to try many paralleled LED, if an LED is disconnected, and the LED current increase little will not affect the remaining LEDs. Power type LED is not fit to pick up the constant current driver for mode in parallel as load. When an LED is a short-circuit fro the poor quality, all the LED will not light, but if there are a larger number of parallel LED, the LED current pass through the short-circuit large ,which lead short circuit into open circuit. By the above analysis, we can see, the selection for driver and load LED series-parallel mode is very important, constant-current power type LED driver are not suitable for the use of parallel load.

7. In the course of PWM dimming or ON/OFF control, the control signal initial power level must be turned on at 2.8V <V_c <6V, close power level must be less than 0.6V. If there is a longer lead between the control source and the pin, please connect an around 100pF capacitor which close to this pin for filtering interference signals.

8. In order to prevent any unexpected status from damaging LED, in general, it will take some method of LED protection. One positive temperature thermistor PTC is a quite effective and reliable way for protection. We can add a PTC protection at the front of each branch circuit separately, and also can add a PTC thermistor all in front of the branch circuit light for the whole protection. When the normal operating current passing through it (or a normal ambient temperature), PTC is in the low resistance state.