

WHAT YOU NEED TO KNOW ABOUT POWER SUPPLIES

Regulated, constant voltage power supply or **Switching mode:**

This supplies a constant voltage. For example, a 12 volt, 500ma power supply will provide exactly 12 volts **regardless of the current draw**, whether it's 100ma or 500ma. Since the voltage varies, a limiting device, such as a resistor, is required on the LED circuit board.

Non-regulated (linear) power supply:

This requires that the LED fixture be designed with power regulating circuitry. A 12 volt, 500ma power supply provides 12 volts with a 500ma load. But, if the load is only 100ma, the voltage can rise to 18 volts. 200ma loads can bring the voltage up to 16 volts. So depending on the current load, the voltage would change! **This can damage a Led or reduce its expected working life.**

Linear versus switch-mode power supplies

Introduction

Linear power supplies were the mainstay of power conversion until the late 1970's when the first commercial switch-mode became available. Now apart from very low power wall mount linear power supplies used for powering consumer items like cell phones and toys, switch-mode power supplies are dominant.

So what is the difference in how they work? – (Techy stuff)

Linear power supplies have a bulky steel or iron laminated transformer. This transformer has two purposes:

- It provides a safety barrier for the low voltage output from the AC input and reduces the input from typically 115V or 230VAC to a much lower voltage around say 30VAC.
- The low voltage AC output from the transformer is then rectified by two or four diodes and smoothed into low voltage DC by large electrolytic capacitors.

That low voltage DC is then regulated into the output voltage of choice by a dropping the difference in voltage across transistor or IC (the shunt regulator).

Switch-mode supplies are a lot more complicated.

The *115V or 230VAC* voltage is rectified and smoothed by diodes and capacitors resulting in a high voltage DC.

That DC is then converted into a safe, low voltage, high frequency (typically switching at 100kHz to 500kHz) voltage using a much smaller ferrite transformer and FETs or transistors. That voltage is then converted into the DC output voltage of choice by another set of diodes, capacitors and inductors. Corrections to the output voltage due to load or input changes are achieved by adjusting the pulse width of the high frequency waveform. Sounds complicated? Yes, but the pay off is worth it!

The advantages and drawbacks of both technologies

Size: - A 50W linear power supply is typically 3 x 5 x 5.5", whereas a 50W switch-mode can be as small as 3 x 5 x 1". That's a size reduction of 80%.

Weight: - A 50W linear weighs 4lbs, a corresponding switcher is 0.75lb. As the power level increases, so does the weight. I personally remember a two-man lift needed for a 1000W linear.

Input Voltage Range: - A linear has a very limited input range requiring that the transformer taps be changed between different countries. Normally on the specification you will see 100/120/220/230/240VAC. This is because when input voltage drops more than 10%, the DC voltage to the shunt regulator drops too low & the power supply cannot deliver the required output voltage. At input voltages greater than 10%, too much voltage is delivered to the regulator resulting in over heating. If a piece of equipment is tested in the US and shipped to Europe, or even to Mexico in some cases, the transformer "taps" have to be manually changed. Forget to set the taps? The power supply will most certainly blow the fuse, or may well be damaged. Most switch-mode supplies will operate anywhere in the world (85 to 264VAC), from industrial areas in Japan to the outback of Australia without any adjustment. The switch-mode supply will also be able to withstand small losses of AC power in the range of 10-20ms without affecting the outputs. A linear will not. No one will care if the AC goes missing for 1/100th of a second when charging your phone, it will take 100 of these interruptions to delay the charge by one second! Having a piece of equipment reboot 100 times a day will cause some heartbreak!

Efficiency: - A linear power supply because of its design will normally operate at around 60% efficiency for 24V outputs, whereas a switch-mode is normally 80% or more. Efficiency is a measure of how much energy the power supply wastes. This has to be removed with fans or heatsinks from the system. For a 100W output linear, that waste would be 67W. A 100W switch-mode would be just 25W.
 $67W - 25W = 42W$ is the extra power lost

Doesn't sound much, but don't try touching a 40W light bulb! If the equipment were running 24 hours a day, then the extra losses would be 367kW hours, even at \$0.1 per kW hour, that's an extra \$37 a year for a power supply that costs around \$80.

As a quick note, in Europe, they are trying to limit those losses of all power supplies used by consumers particularly when operating off load (as many products are left plugged in 24 hours a day). Imagine 250 million power supplies eating up a couple Watts. That equates to the output of a whole power station!

Reliability: - If reliability is calculated using a part count method, then the linear power supply will win. With the design & quality improvements made in the last few years with switch-mode parts & technology, in reality this advantage has been negated. I have demonstrated life testing data showing no failures after over 1,000,000 hours.