Wiring LED COB's in Series/Parallel

INSPIRED LIGHTING

The most efficient way to run high power LEDs is using a series circuit with a constant current LED driver. Running a series circuit helps to provide the same amount of current to each LED. This means each LED in the circuit will be the same brightness and will not allow a single LED to hog more current than another. When each LED is receiving the same current it helps eliminate issues like thermal runaway.

Wiring COB's in Series

Series wiring is used most often with constant current drivers. When you wire in series, you add the forward voltages of each LED in the circuit but the current fed to each LED remains the same. If you have 3 LED COBs, each with a forward voltage of 36V at a given current, when you wire them in series, the total voltage drop of the circuit becomes 108 Volts. If, for example, your LED driver produces 1400mA of current within a voltage range of 100-150V, then as long as your total voltage drop of your circuit is within the 100-150V range (our circuit of 108V would work), then all 3 of these COBs will receive the full 1400mA.

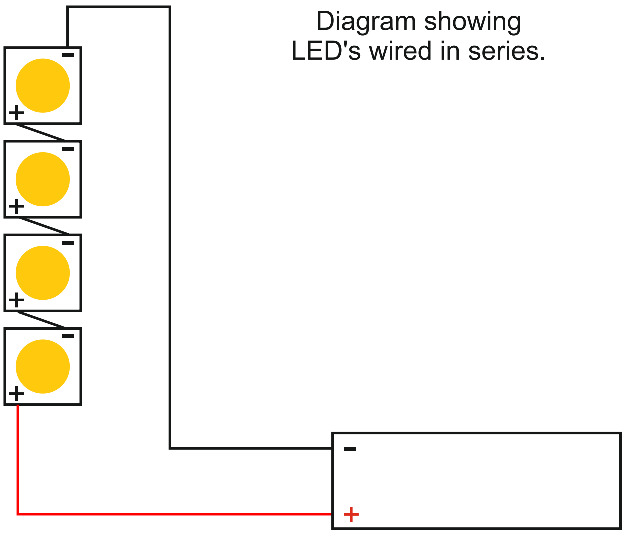


Diagram showing LED's wired in series.

Wiring COB's in Series

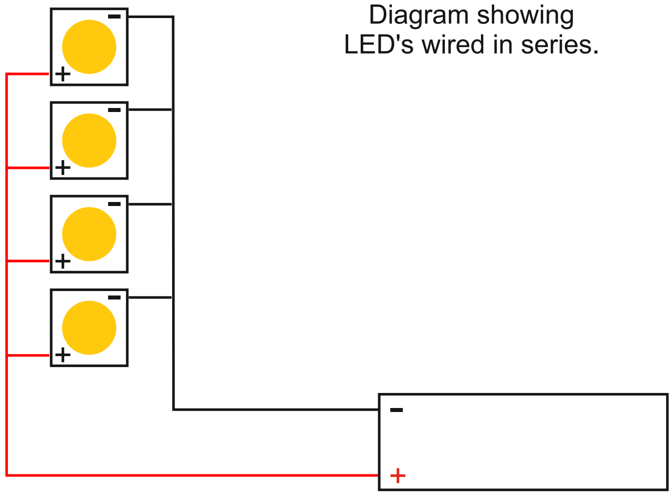
Parallel wiring is most often used when working with constant voltage drivers. A lot of people are now using constant voltage drivers and wiring up their COBs in parallel, since the drivers are usually cheaper and people are more comfortable working with low voltages like 36V, as opposed to high-voltage series circuits that can be 200V+. One drawback is the fact that wiring COBs in parallel does make them vulnerable to thermal runaway.

Thermal runaway refers to the process that occurs when a COB heats up, causing it to draw more current, which heats it up further, drawing even more current, and this loop continues until it destroys itself. Unless you implement something like a resistor to limit the maximum current, there's nothing stopping the COBs from pulling as much current as the driver will provide if the COBs go into thermal runaway, or the voltage output of the driver rises. That being said, in my own testing, current levels have always stabilized at reasonable drive currents and I have only seen thermal runaway occur at very high currents that nobody is going to run at (3+ amps per COB!).

Now, when you wire in parallel, the forward voltages of each LED no longer add together like they do in series. If your driver outputs 36V, then every single COB that you have hooked up to it in parallel will have that same 36V across it. Instead, the current is what becomes split among the LEDs in a parallel circuit.

For example, your COB data sheet may tell you that when you apply 36V, each of your COBs will pull about 2,400mA of current. So, if you have 2 of these COBs on a 36V constant voltage system, your driver would need to be able to supply at least 4.8A of current. If it can do more, that's fine – the COBs will only pull what their particular unique current-voltage curve dictates, depending on what voltage you run them at. They may each pull 2,400mA when you put 36V across them, but jump to 2,700mA each when you put 36.5V across them.

You can also wire COBs in parallel on a constant current driver. When you wire in parallel on a constant current driver, you don't have to worry about the COBs pulling any more current than the driver is rated for, but the current will not necessarily be evenly split among the COBs. You could have 2 identical COBs in parallel on a 700mA constant current driver, and one COB could be pulling 500mA while the other only pulls 200mA, due to small differences in the composition of the LEDs in each COB.



Combining Series and Parallel Wiring

There may be instances where you need to combine series and parallel in order to match a certain number of LEDs to a driver properly. Generally, it's better to just add more drivers to keep things simple and in series, but if need be, you can work some magic to make what you've got work.

If, for example, I wanted to run 8x CXB3590s (36V) on my driver that's rated to do 1400mA between a voltage range of 71V and 143V, I could not hook them up in serial. Hooking all 8 up in serial would give me a total voltage of 288V, which is way out of range. What I could do, though, is wire 2 strings of 4 series-connected COBs in parallel. Each string would have a voltage of ~144V (a little less due to the low current) and would draw 1400mA of current. If these 2 strings were then wired together in parallel, the voltage of 144V would remain the same, but the current of 1400mA would be divided among them, giving each COB in each string 700mA.
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