Single Wired Electric Path rather than Double for Light Lamps On-Off

Abstract

In this idea, I have used a technique in order to reduce 2 phase wires to 1 wire in electric wiring. As all know, in order to turn ON/OFF two electric light lamp independently, we need to use two switches. Consequently, we also need to use two wires (except null (ground) wire) for achieving this purpose as it has been depicted in Fig. 1. However, as it can be seen in the Fig. 2, by using a simple idea of modulation, there is only a single wire which conducts electrical current for lamps. If someone wants to turn ON/OFF lamps independently, they can easily do it by closing/opening either of the switches. The current for supplying the L1 is provided in positive half cycles through D1, D3, and for L2 is provided in negative half cycles through D2 and D4. It stands to reason that the two lamps can be controlled independently. In order to compensate supplying power for lamps (because the effective voltage is reduced in a half-wave in comparison with a full-wave) we can use capacitors to provide energy in positive half cycles for L2, and vice versa. The appropriate capacitance for the capacitors is calculated in the following.

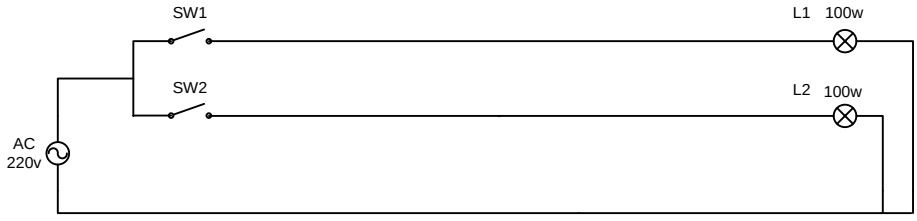

Figure 1: Double wire schematic

Figure 2: Single wire schematic

For the architecture of Fig. 1, since the lamps see perfect sinusoidal wave on their ports we have $V_{rms,DW} = \frac{V_m}{\sqrt{2}}$

For the architecture of Fig. 2, based on Fourier coefficients the root mean square voltage (V_{rms}) for either of the lamps will be:

$$V_{rms,SW} = \sqrt{\sum_n V_{n,rms}^2 = V_{DC}^2 + \frac{1}{2}\sum_n (a_n^2 + b_n^2)} \approx V_{DC} \approx \frac{V_m}{1+\frac{1}{2R_L f C}}.$$

The lamps in the both architectures will light the same if they receive the same effective voltage; thus:

$$V_{rms,DW} = V_{rms,SW} \rightarrow \frac{V_m}{\sqrt{2}} = \frac{V_m}{1+\frac{1}{2R_L f C}} \rightarrow 0.4 \approx \frac{1}{2R_L f C} \rightarrow C = \frac{1}{0.8R_L f}.$$

In case of using a 100w lamp, its internal resistance will be $R_L = \frac{V_{rms}^2}{P} = \frac{220^2}{100} \approx 500\Omega$.

At last, if the standard frequency is 50Hz, the capacitance of the capacitors is calculated by using the above-mentioned relation:

$$C = \frac{1}{0.8R_L f} = 50\ \mu\text{F}\ .$$

Benefits

1. Converting a single channel light ON/OFF to a double independent channel without changing the structure of wiring.
2. Reducing the amount of copper to half.
3. Reducing complexity of wiring, maintaining, and repairing for technicians.

Conclusion

With a simple idea of modulation, using 4 diodes and 2 capacitors, a single ON/OFF electric channel (of course considering the Null wire it will be 2 wires) can be converted to a double channel which have some advantages which were briefly explained. Of course, this idea can be applied for outlets in which the plugged in electric consumer has no transformer in the input port such as vacuum cleaners, to name but a few.