**Induced Noise with RGB LEDs**

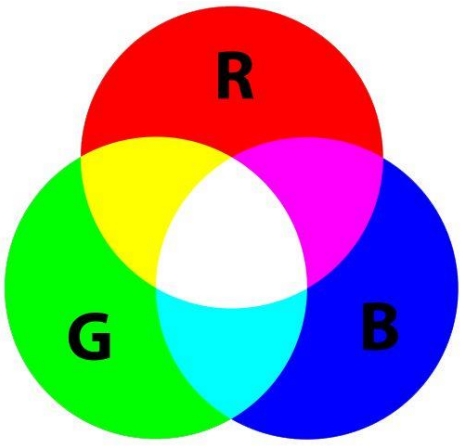
If you are using an RGB LED controller or any external device that changes the LED color **or** brightness, you may have noise issue you will need to address depending on which way the controller changes the LED color or intensity. If you are using single-color LED lights without any additional controller in your application, you will not have any noise issues because you will be powering the LEDs with a constant DC voltage source. DC voltage does not create any electromagnetic interference (EMI).

To understand why a controller is needed to change LED colors, we must know how LEDs produce colors.

The three most common colors of LEDs (red, green, and blue) can be used independently for a solid color, or they can be combined to produce almost any color desired.

**Examples: red and green combined produce yellow, blue and red produce violet, yellow and blue produce green.**

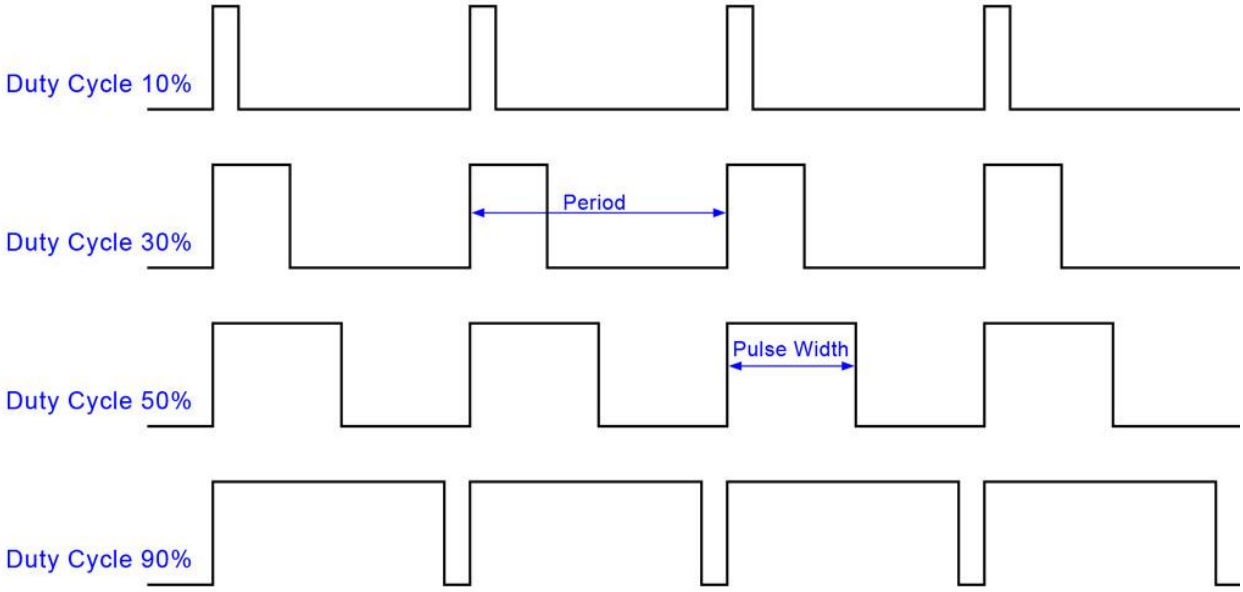
**If you combine all three at equal brightness you will get white.**




To obtain various colors of LED light other than the 3 standard LED colors, you will need to combine 2 or 3 of the LED colors and/or vary the brightness of any of the three standard LED colors.

There are two ways to change brightness of LEDs. One method is to change the current supplied to the LEDs by changing the resistance. This is by far the simplest, but it has limitations. LEDs require a minimum voltage (1.7 to 3.3 volts) to illuminate and have a maximum current draw (typically 20mA) before failure. This will limit the range of colors and the brightness that can be achieved.

The other method used to change brightness or color of RGB LEDs is by pulse width modulation (PWM). This "pulses" the LED on and off at variable durations at a constant voltage.




The pulse rate at which the LEDs are turned on and off is so fast our eyes cannot detect the LEDs turning on and off. They will appear to be not as bright at lower-duty cycles and brighter at higher-duty cycles. By applying this technique to the three primary-color LEDs, you can achieve a huge range of colors and brightness for desired results. If the manufacturer does not indicate what method of controlling the LED is, you will have to use an oscilloscope to test the output to see if they are using PWM.

The bad news – switching DC voltage on and off causes a pulsing magnetic field around the wires that are carrying the voltage to the LED. When this pulsing magnetic field passes through nearby signal wires, it will induce a small amount of voltage into the wire. The amplifier will amplify this unwanted pulsing voltage, and we will hear it as "noise".

**Solutions and precautions:**

Good installation practices are always the best to follow for acceptable results with any audio/video systems. With LED RGB lighting you may need to go a step further than you expected. If you are using a PWM based controller, you will need to do the following:

1. Make sure your source unit is wired directly to the battery and not through the main harness of the vehicle.

2. Always use twisted-pair RCA cables for the best possible noise rejection.

3. Use amplifiers (such as all KICKER amplifiers) that do not use single-ended inputs where the shield of the RCA is grounded to chassis ground.

4. Always use a highest signal voltage available such as speaker level when sending audio signals to an amplifier. KICKER amplifiers are equipped with **F.I.T.** (Fail-safe Integration Technology) which have a 10-to-40-volt signal-input capability.

(see https://www.kicker.com/app/misc/support/tech/tech_papers/docs/FITInputs.pdf for more information).

5. Make sure LED wires are run as far as possible from all audio signal wires.

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