General Information

PWM stands for Pulse Width Modulation. PWM is used as a method of controling power on an output driver of an electronic control module. It can be use to control power to any number of devices. In the automotive industry, examples include, but are not limiteds to, incandescant lighting, O^2 sensor heaters, trailer brake control output and fan motors.

How PWM Works

Rather that controlling the voltage level of the output, a PWM output switches the battery voltage on and off at a given frequency. This is typically between 90 and 150 Hz. The resultant output will look like a square wave. The microprocessor varys the on time vs the off time. So, if a lower power output is required, the on time will get less and the off time will get proportinally greater. Conversely, as more power is required the off time will get less and the on time will get proportionally greater. The output is expressed in a percentage of on time versus off time. A 95% PWM would mean that the output is on 95% of the time and off 5% of the time. Due to hardware constraints, most PWM drivers can not operate at 0 or 100 percent. Typical operation is between 2% to 98%.

Figure 1 shows an example of what a PWM output would look like on an oscilloscope. A 50% PWM is on half of the time and off half of the time. It gives the appearance of a classis square wave signal. The area under the curve (shown in light blue) is mathematically proportional to the power going to the device. The higher the PWM percentage, the more blue there is, the more power there is.

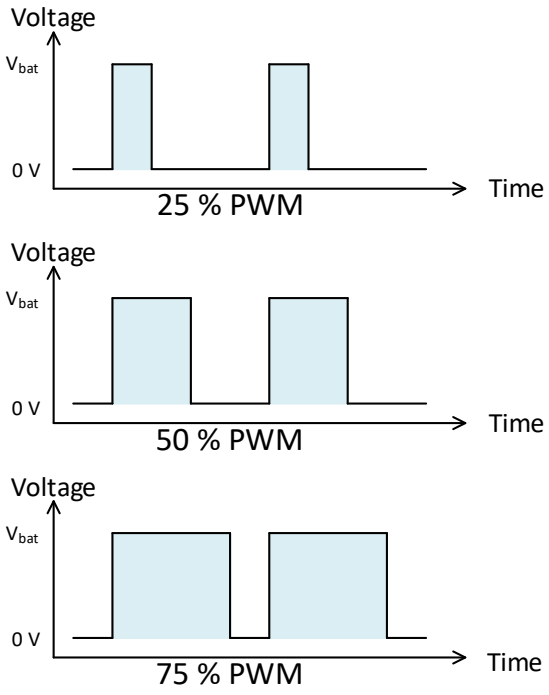

Figure 1

Pulse Width Modulation (PWM)

Usages

PWM can be usaed to control temperature on the O^2 sensor heaters for gasoline engines. If the temperatiure is too low, the ECM increases the PWM percentage applying more powe to the heater element. If the temperature is too high, the ECM decreases the PWM percentage to lower the temperature.

PWM can also be used to control the speed of a fan motor. The principle is the same. The higher the desired fan speed, the higher the PWM percentage.

The most common use of PWM on Ram vehicles is for lighting control of incandescant bulbs. LED lamps will not be PWM controlled as most LEDs can not tollerate lower PWM percentages. Once the percentage gets to around 90% or below, LEDs will start to flicker and eventually quit workig all togheather.

All incandescant bulbs on the exterior of Ram vehicles are PWM controlled. The PWM percentage is scaled to the system voltage to maintain consistant power to the bulb. As system voltage goes up, PWM percerntage decreases, maintaining consistant power. This greatly extends bulb life and reduces light intensity fluctuation.

Figure 2 is an example of the voltage and PWM values typically seen in Ram lighting circuits. With the engine off, the battery voltage will be in the area of 13 volts and the PWM percentage will be 95 to 98 percent. Once the engine is started, the alternator will start charging and the battery voitage will work it's way up to 14.2 to 14.5 volts depending on ambient temperature. At these voltages, the PWM perentage will be down around 85%. If the area uder the curves in **figure 2** were analyzed they would be nearly the same. In this case, the blue areas were analyzed in the native drawing tool. The area under the 95% curve was 247 mm^2. The area under the 85% curve was 246.5 mm^2. That's about 0.2% difference in power output.

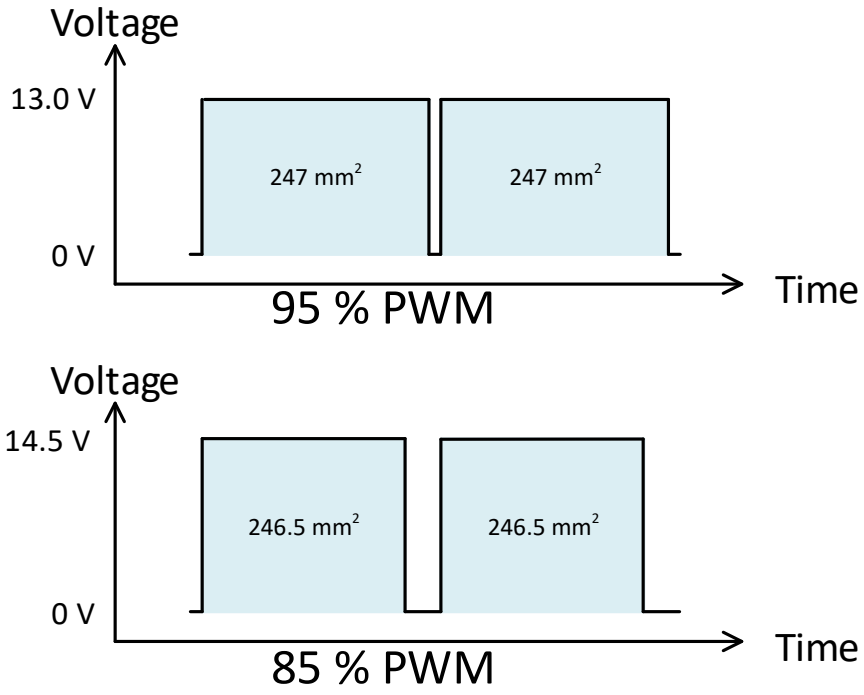

Figure 2

Pulse Width Modulation (PWM)