ELCERAM

High power electronics for professional RC racing

PWM (*Pulse Width Modulation*) adjustment and impact to RC Car behaviour during acceleration and braking

Introduction

PWM - *Pulse Width Modulation* is very common technique for power control for many areas. In case of RC cars we can control voltage on motor windings and thus current through motor. According to trigger position on the transmitter the PWM duty cycle is adjusted, MOSFETs driven and thus the mean/average value of voltage adjusted followed by current flow into motor windings. Just imagine, It is similar like turning water on and off quickly - with some frequency. The result is average amount of water followings out of the water tap. The pressure in water pipeline is our voltage and amount of water our current flow. Less frequency and thus more time tap opened getting more water out.

The voltage on the motor windings *represents the motor speed* equation n = K.Voltage (rpm/min), so more voltage means more rpm according to kV constant.

The current *represents the motor torque* M = k.Current (Nm), so more current will cause more torque because magnetic field becomes more strong and interaction with rotor is stronger.

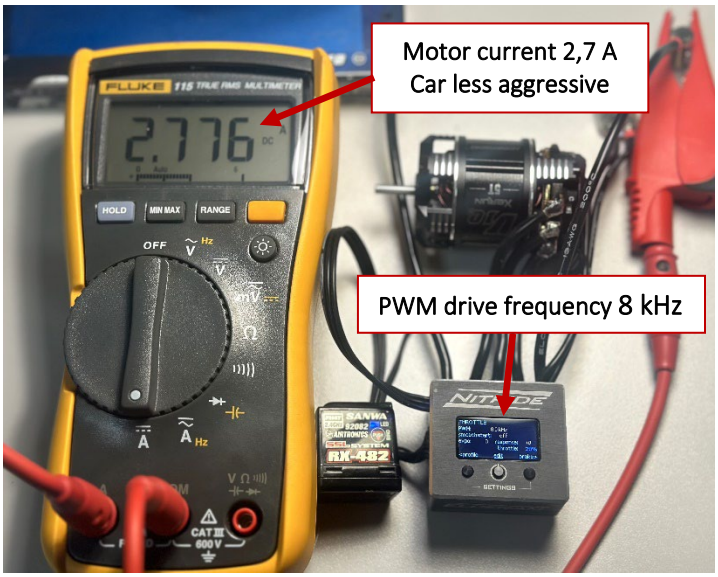
So it is clear that by changing the PWM drive frequency you can significantly change the car acceleration or braking because your motor torque is changed. For every single track / traction condition should be PWM drive frequency found and precisely adjusted.

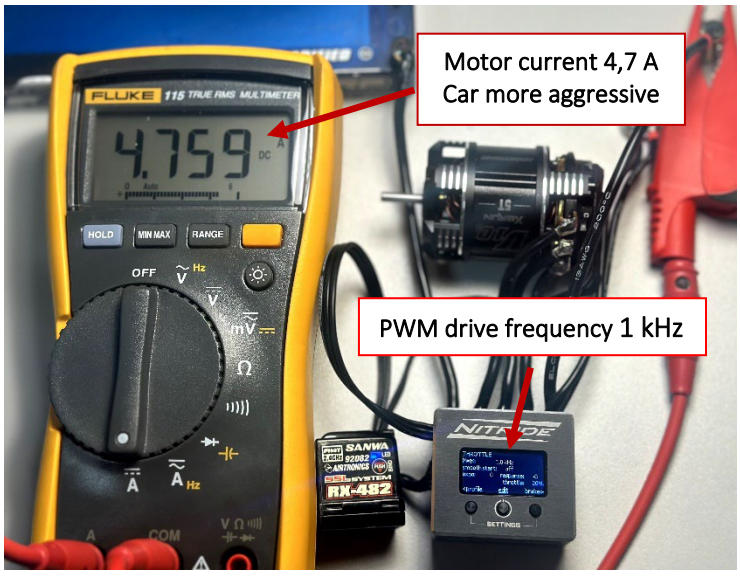
How can I find PWM drive frequency for throttle and brake ?

It is the question of track grip first of all, motors turns and your driving style. For stock is throttle PWM normally between 1 - 2 kHz and for modified between 6 - 9 kHz. To give you an idea two extremes for throttle PWM 1 kHz and 8 kHz at 20 % showed below.

As you can see in the pictures, less PWM frequency will cause the MOSFETs are open longer time and current flow from your battery is higher. For the motor HW 5.0 T is difference even 70 % **!** For 1 kHz current draw 4,76 A and for 8 kHz current draw 2,77 A. With more current your RC car will be more aggressive and you get more bottom end power. But of course your battery will be in shorter time discharged and you need enough grip to transfer torque to the surface. That's the reason why the PWM drive frequency is increased for low traction conditions.

Exactly same principle is for the brake. Less PWM drive frequency for brake will cause your brake more aggressive / stronger. So if you need more brake go with PWM down, typically between 1 - 2 kHz. For stock racing where motor generates less current between 1-1.5 kHz and for modified between 1.5 - 2.5 kHz.





How PWM drive frequency influence your Top speed on the straight during you pressing full throttle ?

Your top speed is independent on the PWM drive frequency :-) By pressing of full throttle the PWM modulation is turned off and full battery voltage is connected to the motor windings.