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Currently working on the oscillator for my New-Gen PWM DC motor controller. The earlier version did not use a power capacitor at the input to smooth the current flowing to the controller. I felt for long-term use in a car this could get pretty noisy. So if adding an input power capacitor I want to keep it physically small and that would suggest increasing the frequency as much as practical.

Previous frequency was around 625 hz and used a 555 timer to generate the frequency and sawtooth signal for PWM. In the past I had tried the early circuit at a much higher frequency. In excess of 20kHz the downstream opamps had not been able to keep up because of slew rate. So in the interest of "simplify and eliminate", can I get rid of some components and do without the opamps that were used before?

Recently reading somewhere I saw reference to an oscillator built around a comparator. Well comparators are very fast and this simple circuit looked compact. Looking through a National datasheet I found several variations of this circuit. Last night I used the one labeled Pulse Generator. My idea was to use the pulse to zero out a capacitor that was charging through a constant current source to generate the sawtooth signal for PWM.

I worked with this first circuit last night (Original Sawtooth Oscillator). Running up in the 43kHz range I could make things work (possibly different values than schematic) but one issue I didn't like in particular. By clamping the cap to ground my saw tooth signal actually went to ground and below. Trying to keep away from a negative power supply this makes it very hard to achieve full 0 – 100% PWM. The reference voltage at the PWM comparator needs to be able to exceed both ends of the sawtooth.

Pondering this problem I think I've found a possible solution – see "New Sawtooth Oscillator". It actually eliminates several components and will end up with the top and bottom of the sawtooth signal being well away from the ground rail and well away from the upper Vcc rail.

Not having tested it yet, here's how I think it will work: R1, R2, R3 and Q1 set up my "poor man's" constant current source for linear charging of the capacitor C1. R4, R5 and R6 set up the comparator trip points, as the output changes from lo state to hi state it changes the reference voltage at the + input, effectively setting the hi and lo points of the sawtooth signal.

When the comparator output goes hi, nothing flows through R8 and D1. Constant current flows through R3 and Q1 charging C1 in a linear manner. As the voltage at the top of C1 climbs to the hi trip value, the comparator trips and the output goes to zero. This causes C1 to start discharging through R8 & D1. This discharge should be very quick.

You might notice R3 never quits flowing current but if R8 flows MUCH faster, the sawtooth signal should be very useable. If this continuous flow through R3 is a problem for the final output wave form (non linear wave form) I can always use the option of R9

& D2 replacing R3. This option would ensure controlled current flow in to the capacitor and controlled current flow out of the capacitor. I hope not to have to use R9 & D2. Testing will tell.

Frequency is primarily set by C1, R3 & Q1 (by extension R1 & R2 control Q1). These same components also control the level of linearity achieved by the output waveform. So the values shown in the schematic are just a starting point and need to be tested and adjusted to achieve proper waveform.

The final frequency should really be chosen along with the input power capacitor. The capacitor needs to be able to accommodate the level of ripple determined by the expected current load and worst-case PWM condition. So what is the worst case PWM? Maybe 70% PWM%? Figure out ripple and select a capacitor – an iterative process.

If this new oscillator circuit works out I could use a dual comparator like the LM393 and have the main control circuit done with one IC. The scond comparator would do the basic PWM comparison and then just need the MOSFET driver (pnp & npn), MOSFET and flywheel diode. The only use of opamps would be for uni-buffers for the progressive input signal.

Test the circuit tonight.

Finished testing. Circuit actually worked pretty well. I moved some resistor values around and ended up settling on 22.2kHz for the time being. The metal poly capacitors just seemed to give a nice straight voltage ramp. The ceramic caps didn't seem to be as stable. Since I didn't have any smaller poly caps than .001uF that became the final value, giving a slower frequency than I had intended but much higher than the old 625hz. Final schematic is posted.