Lab 1: Pulse width modulation

Pulse width modulation (PWM) is widely used in power electronics. From DC to DC conversion to inverter design, it plays an important role. This lab is an insight into the practical implementation of PWM generation.

Equipment

- Op-amp TLE2082
- Comparator LM319
- Breadboard
- Resistors
- Trimmer
- Capacitors

Helpful Reading

- TLE2082 datasheet (http://www.ti.com/product/TLE2082/technicaldocuments)
- LM319 dual comparator (http://www.fairchildsemi.com/ds/LM/LM319.pdf)
- Mohan page 13

Equation for frequency of triangle wave is as follows:

$$F_T = \frac{(R_2 + R_3)}{4R_1(R_4 + R_5)C_1} \tag{1}$$

Aim of the lab

- Design a triangle wave generator.
- Create pulse width modulation (PWM) with varying duty cycle.

Deliverables

1. Calculate the capacitor value required to achieve 30kHz switching frequency in the circuit shown below (assuming the trimmers are set to 0).
2. Calculate the range of frequencies that could be achieved with the circuit below.
3. Draw a schematic of the triangle wave circuit (pictured below) connected to an LM319 comparator so the triangle wave can be compared to a DC signal. Ensure you show component values and IC pin numbers

4. Assuming you are switching an IRFBC40APBF MOSFET (which we will use in lab 2) with 12V across it at 1A with a duty cycle of 50%, calculate the conduction losses and switching losses of the MOSFET for the minimum and maximum switching frequencies that could be achieved with this circuit.

5. Using deliverable 1 and 3, connect your circuit on a breadboard, ensure you add a capacitors to the supply rails of the opamp and comparator. The output of the comparator will need a pull-up resistor and the inputs should be connected in a way that when the DC voltage is increased, the PWM duty cycle increases. Vary the DC voltage to observe PWM duty cycle from 0% to 100%. Show your lab tutor

6. Take an oscilloscope screen shot of the DC signal crossing the triangle wave and PWM output for a single duty cycle.

7. Comment on why the theoretical frequencies calculated above could not be achieved.

8. Describe how you might get both an inverted and non-inverted signal?

9. Using a block diagram, identify the circuits used in this topology and briefly explain how the circuit works (hint: there are two "sub-circuits").