DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

ENEL 372 – POWER ELECTRONICS 1

Pulse Width Modulation

One of the fundamental control mechanisms for power semiconductors is to use high frequency on-off Control or Pulse Width Modulation (PWM).

The TL494 is a fixed frequency, Pulse Width Modulation Control IC designed primarily for switchmode power supply control. This experiment will take you through a step-by-step process of setting up the TL494 on breadboard and using it to generate both single-ended and push-pull output control signals. The manufacturer's data sheet for the TL494 should be used with this lab sheet.

1. Connect a DC power supply (12-15V) to the TL494. During this experiment we will not be varying the deadtime control or using the error amplifiers, so pins 1, 2, 4, 15 and 16 should all be tied down to ground.

2. Use Figure 3 in the data sheet to choose timing components to achieve an oscillator frequency of about 50 kHz. What values of R_T and C_T did you choose? On which pin does the sawtooth waveform appear? Measure the amplitude and frequency of the sawtooth.

3. Measure the Reference output voltage at pin 14. Use a 10k pot to generate a variable voltage from the Reference output voltage. We will use this variable voltage as the control signal and it will be fed to pin 3.

4. <u>Single-ended Configuration</u>

   Using the information of Figure 17 of the data sheet connect your TL494 in the single-ended configuration. Remember that the chip outputs Q_1 and Q_2 are open collector and you will need to tie the emitters to ground via a resistor. You will also have to connect the Output Control pin 13 appropriately.
   - What value resistor would you choose and why?

   Now vary your input control voltage at pin 3 from 0 to maximum, while observing the output from Q_1 and Q_2.
   - What is the maximum control voltage to produce any output?
   - What is the minimum control voltage when the output saturates?
   - What is the maximum duty cycle you can achieve?
   Make a copy of the output for your lab book.

5. Push-Pull Configuration

    Again using the information of Figure 17 of the data sheet reconnect your TL494 in the push-pull configuration. Check your emitter resistors are chosen appropriately. Again check minimum and maximum control voltages to produce an output from Q_1 and Q_2. Make a copy of the outputs for your lab book. Measure the deadtime. How does this compare with the manufacturer's prediction? Why do we need to include deadtime in this control strategy?

6. If you have time you might like to experiment by varying the deadtime and comparing your measured outcome with the manufacturer's prediction.[i]